UNIVERSITY OF CAPE TOWN

FACULTY OF HUMANITIES

A COMPARISON OF SCIENCE TEACHERS' AND STUDENTS' PRIORITIES FOR IMPROVING THE TEACHING AND LEARNING OF SCIENCE IN LESOTHO HIGH SCHOOLS IN THE 21st CENTURY

A dissertation submitted to the University of Cape Town in fulfilment of the requirements for the degree of MASTER OF EDUCATION

by

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September, 2000

DECLARATION

I declare that this dissertation is my own unaided work. It is being submitted for the degree of Master of Education of the University of Cape Town. It has not been submitted before for any degree of examination in any other university.

signature removed

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ABSTRACT

The 1995 *Report of the National Seminar on Lesotho Secondary Education Policy: Localisation of the O'level Curriculum* stated that there was a need to review the goals and policies which were to serve as a government framework for the development of new curriculum materials. It is in this context that this study was conducted.

The purpose of the study was to determine, with reasons, which of 20 literature-derived policy recommendations proposed for the improvement of the teaching and learning of science would be most highly prioritised and agreed upon by 171 Lesotho science teachers and 368 science students in 1999.

The null hypotheses tested were :-

(i) There will be no significant difference between the responses of the Lesotho high school science teachers (sample 1), the Lesotho primary school science teachers (sample 2) and the Lesotho senior high school science students (sample 3) in their frequencies of agreement/disagreement with each of the 20 proposed science policy recommendations.

(ii) There will be no significant difference between the responses of the Lesotho high school science teachers, the Lesotho primary school science teachers and the Lesotho senior high school science students in their best/least important priorities for each of the 20 proposed science policy recommendations.

To test the hypotheses, samples of 368 senior high school students, 77 primary school science teachers and 94 high school teachers in ten schools responded to a questionnaire comprising biographical data, an agree/disagree response section, and selection of the two best/least preferred policy recommendations backed up with the respondents' own reasons. In addition, all respondents were asked to suggest important additional ways in which the teaching and learning of science might be improved in Lesotho schools.

Using two convenient additional separate samples of ten respondents, the test/re-test reliabilities (r) of the 20-item survey instrument were found to vary between $r= 0.95$ and $r= 0.97$ over an interval of two weeks.

The quantitative response data was analysed using the chi-square test (χ^2) for 2 × 2 contingency tables. Fisher's z exact probability test was used for tables with frequencies less than five.

The qualitative responses were analysed by collating, classifying (coding) and systematically presenting a considerable amount of explanatory data.

The findings were: that the null hypotheses for (i) were rejected for the following policy recommendations: *'More emphasis on gender issues'*, *'Promoting careers in science, 'Increasing excitement and adventure in science', and 'Introducing core plus options curriculum'.*

The null hypotheses (ii), were rejected for: *'More real life skills in science', 'More attention to language issues', ' Better teaching methods' and ' More competitions in science'.*

Substantial measures of agreement were found to exist among the samples' policy preferences. All three samples, comprising a total of 549 respondents, consistently highly prioritised *'Acquiring more resources', 'Arranging more competitions in science', and 'Having better teaching methods'* as their most important policy recommendations for improving the teaching and learning of science in Lesotho schools. The two policy recommendations which were adjudged to be of *least* importance were issues of *language* and *gender*.

The study also reports in detail the three samples' concerns and needs which they expressed qualitatively. They particularly sought *'More resources'* - through raising funds, curriculum reviews, increasing the number of universities, etc.; '*More teacher support*' - in terms of rewarding salaries, more in-service and pre-service training, regular workshops, more seminars and part-time studies; and '*More learner support*' - in the form of increasing visits to science institutions, the incorporation of career guidance into school science lessons right from primary school level, and so on.

In addition, full-length auxilliary interviews were conducted with five Lesotho senior high school science students and five Lesotho high school science teachers individually for periods of up to one hour. The interview data revealed that the already existing science teaching materials are not efficiently used, although the need for more of these resources was highly prioritised in the questionnaire response data.

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LIST OF ABBREVIATIONS

BoLeSwa	Botswana, Lesotho and Swaziland
COSC	Cambridge Overseas School Certificate
ed.	editor
eds.	editors
et al.	and others
GNP	Gross National Product
JC	Junior Certificate
LAC	Lesotho Agricultural College
MOE	Ministry of Education
NCDC	National Curriculum Development Centre
NTTC	National Teachers' Training College
NUL	National University of Lesotho
PSLE	Primary School Leaving Examination
RSA	Republic of South Africa
std	standard
°C	degrees Celsius
χ^2	chi-square

PREFACE

The research findings reported in this dissertation have been presented at two national conferences in South Africa and at one international conference in Germany, after refereeing. They have resulted in the following publications, full copies of which are attached in appendix 1:-

(1) Moru, A. & Rochford, K. (1999)
SAQA and NQF policy issues in the design of a new professional curriculum for Science teacher education: a statistical comparison of the policy priorities of 539 Science teachers in Lesotho and in five South African provinces from 1996 to 1999. *South African Journal of Higher Education*, 13(2), pp. 142 - 155.

(2) Moru, A. (1999)
Science education for Lesotho schools in the year 2000: concurrence between the policy priorities of science teachers and science students. In: The Pursuit of Excellence in Science and Mathematics Education. Seminar Series, 3(1&2), School of Science and Mathematics Education, University of the Western Cape. Ogunniyi, M.B (ed.), pp 20 – 25.

(3) Moru, A. & Rochford, K. (1999)
SAQA and NQF policy issues in the design of a new professional curriculum for science teacher education. Abstracts of the 11th Biennial Congress of the South African Association for Research and Development in Higher Education, 29 June-1 July, Peninsula Technikon, Cape Town, pp. 32-33.

(4) Moru, A. & Rochford, K. (2000)
Congruence between the policy priorities of science teachers and science students In Lesotho for the year 2000. Paper presented at the *Proceedings* of the 8th Annual Conference of the Southern African Association for Research in Mathematics and Science Education, University of Port Elizabeth, 19-22 January 2000, in press, Mahlomola (ed.), Vista University.

(5) Rochford, K & Moru, A. (2000)
Teachers' and students' common recommendations for science and technology curriculum advancement in Lesotho. *Proceedings* of the 2nd Global Congress on Engineering Education, Wismar, Germany, 2 - 7 July. Pudlowski, Z. J. (ed.), Monash University, Melbourne, Australia pp. 430 - 433.

CHAPTER 1

INTRODUCTION

1.1 Setting and purpose of the investigation

Lesotho (the setting of the study), has a population of approximately 2.5 million and is mostly rural. It has two official languages, English and Sesotho. Lesotho is a mountainous country that is completely surrounded by South Africa (figure 1.1 on page 6). It is situated between 28° and 31° South and between 27° and 30° East. The area of Lesotho is approximately 30, 300 km^2 and all its land is 1000m above sea-level. As to its highest point, Lesotho cannot compete on a world scale, but the mountain Thabana-ntlenyana at 3, 481 m, is the highest in Southern Africa. The eastern three-quarters of Lesotho is occupied by rugged and largely inaccessible maloti. Only the western quarter of the country consists of the so-called lowlands, at about 1500-1600 m above sea level. The lowlands contain seven of the ten districts (i.e. Butha-Buthe, Leribe, Teyateyaneng, Maseru (capital), Mafeteng, Mohale'shoek and Quthing), most of the population and the best agricultural land.

Lesotho's only important natural resource is water. Its economy is based on subsistence agriculture, livestock, and remittances from miners employed in South Africa. A small manufacturing base depends largely on farm products which support the milling, canning, leather, and jute industries. Although drought has decreased agricultural activity over the past few years, completion of a major hydropower facility in January 1998 now permits the sale of water to South Africa, generating royalties that will be an important source of income for Lesotho. Civil disorder in September 1998 destroyed about 80% of the commercial infrastructure in Maseru and two other towns. Since the insurance companies could not compensate, the rebuilding will be a significant challenge in terms of both economic growth and employment levels. The GNP of the country is approximately $590 per capita.

Lesotho enjoys a temperature climate with well marked seasons. Temperatures on the western plains range from 32° C in summer to -7° C in winter. Summer is the rainy season and the annual rainfall occurs in the seven months from October to April. Precipitation is rare during the winter months from May to September, but when it occurs it takes the form of snow in the maloti and sometimes also in the lowlands which usually experience at least one fall per year. Snowfall is not confined to the winter months and can occur in the maloti in any month of the year, while in the lowlands it is recorded in every month from April to December. Such unseasonal snow usually follows several days of rain and falling temperatures.

Lesotho, formerly governed by the United Kingdom as the protectorate of Basutoland, gained independence in 1966. This stimulated an increased determination by the Basotho people to restructure the education system so that it would provide training relevant to the country's economic development (Education Sector Development Plan, 1991/92-1995/96:1). The government of Lesotho has recently significantly increased spending on education, more especially on science education, which had been neglected for centuries (Talukdar, 1996b:9).

In 1993, a national Task Force handed to the government a report based on the problems facing the schools and the aspirations of the Basotho people. It incorporated a careful analysis of the constraints and strategies to be considered in meeting the challenges of human resource development over the next fifteen to twenty years (Ministry of Education, Education Sector Development Plan, 1991/92-1995/96:1).

The 1991/92-1995/96 Education Sector Development Plan, Ministry of Education, further stated that the first priority was to concentrate on primary schooling of good quality. This was intended to help the Basotho children to achieve the basic skills of literacy, numeracy and problem solving; and to have the tools they need to make a better future for themselves, their families, and their society (p.2).

The Education Sector Development Plan introduced the broad goals and policies for the system (1991/92-1995/96) as follows:-

> " (a) Education should be provided the opportunity to develop competencies necessary for personal growth and social life through the provision of universal primary education;
>
> (b) Sufficient numbers of individuals should be provided with appropriate occupational, technical and managerical skills to ensure the country's socio-economic development;
>
> (c) Opportunities for continuity education should be provided through non-formal programmes in literacy, numeracy and basic skills: agriculture, community development and vocational training programmes; and in-service education in industry, government and organisations;
>
> (d) Education programmes should incorporate cultural values and activities that enhance individual and social development, in particular;
>
> (e) There should be an active, co-operative partnership in educational

> administration and management and the provision of educational services between and among the churches and other non-governmental organisations." (p.5)

Thus, the purpose of this investigation in 1999 was to make a more detailed study of the most important current policy recommendations for the teaching and learning of Lesotho school science curricula, by targeting the following four outcomes in the present study:-

1.2 Objectives of the study and statement of the problem

The objectives of the investigation are:-

(1) to develop an efficient literature-derived data gathering instrument to assess the curriculum priorities of a wide sample of students and teachers in order to make recommendations for improving the teaching and learning of science in both primary and high schools in Lesotho;

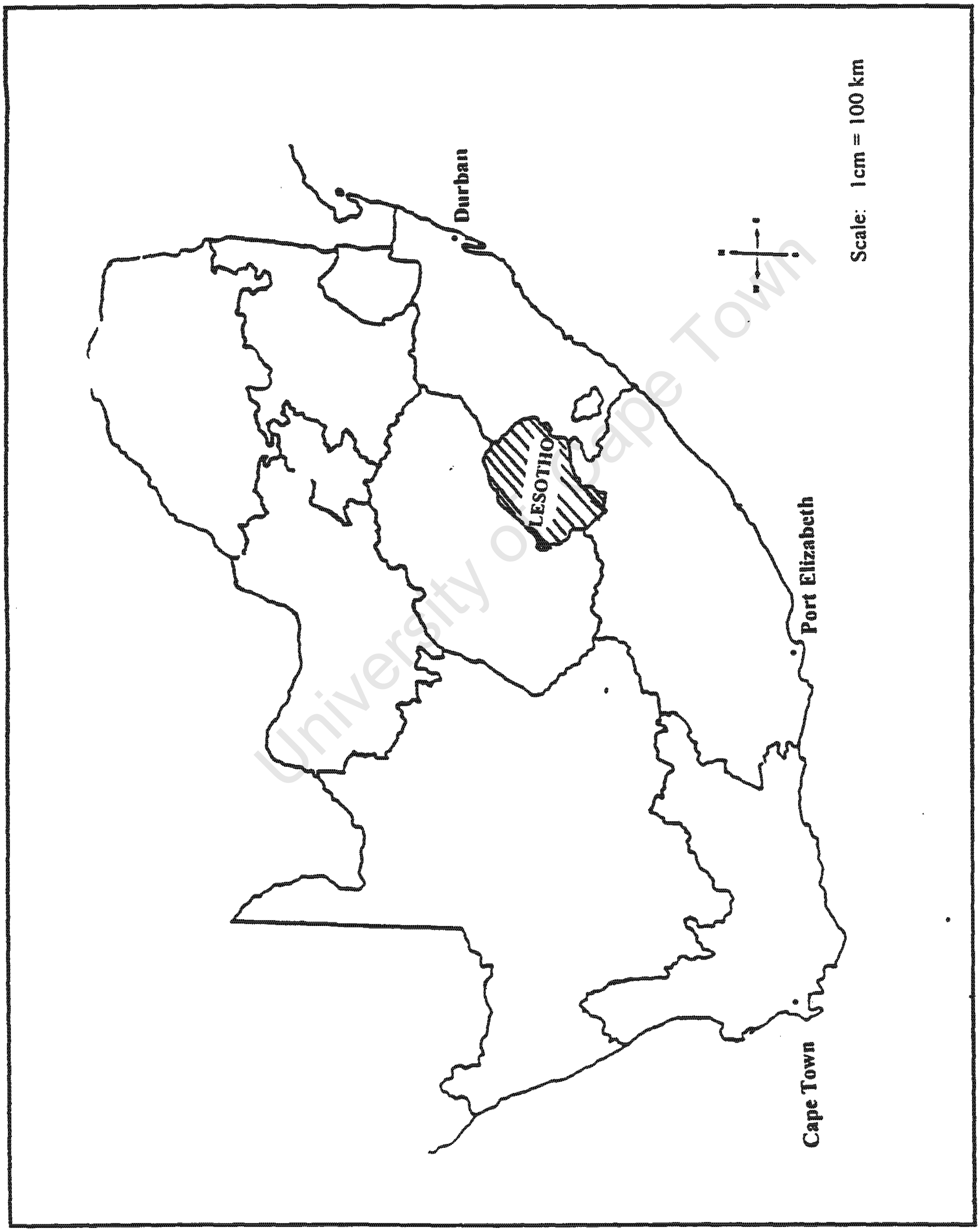
(2) to compare the responses of the various interested groups for similarities and significant differences;

(3) to determine which of the twenty policy recommendations presented for the improvement of current programmes of science would be highly prioritised and agreed upon in 1999 by samples of 98 Sesotho-speaking high school teachers, 77 Sesotho-speaking primary science teachers and 368 high school senior science students in the various districts of Lesotho; and

(4) to try to find means and ways of identifying the most promising strategies for

providing science education in a meaningful and efficient way (c/f Calloids *et al.* 1997:3).

Fig. 1.1 Map depicting the location of Lesotho in Southern Africa



1.3 Origin and background of the study.

> "Curriculum reform is a recognition of needs by practitioners for improving or justifying the process of education. It is an admission that the existing curriculum is either inefficient or does not meet the desired expectations. Curriculum reforms in a way reflects educational change - i.e. a deliberate attempt to improve practice in relation to desired objectives" (Ogunniyi, 1996:69).

The Ministry of Education's Education Sector Development Plan (1991/92-1995/96) raised a concern that the lack of a clearly defined set of national priorities in the area of curriculum brought forth shortcomings in the education system. (p.45)

The education system in Lesotho is structured in such a way that primary education is a seven year cycle, i.e. standard 1, standard 2, ..., standard 7, at the end of which pupils take the Primary School Leaving Examination (PSLE). The junior secondary education takes three years, namely, form A, form B and form C, and at the end pupils take the Junior Certificate (JC) examinations. The next two years lead to "O" level Cambridge Overseas School Certificate (COSC). For higher education, Lesotho has only one University, the National University of Lesotho (NUL), one agricultural college, the Lesotho Agricultural College (LAC), three technical schools and a number of vocational schools.

In the first four years of primary schooling, the medium of instruction is Sesotho. In higher classes the medium of instruction is English although, in some cases teachers, still resort to Sesotho, as English is a foreign language. Nonetheless, it is still very difficult to resort to Sesotho completely since the textbooks used for other subjects (including science) are written in English. Despite this there are some technical terms which cannot be replaced by Sesotho terms, because of the nature of the language (Sesotho).

Recent studies have shown that the state of science education in most African countries has deteriorated during the last decade. The obstacles which still stand in the way of effective science teaching programmes remain the shortage of teachers; inadequate textbooks and facilities; weak communications networks; conflicting policies; and the slow rate of information transmission (Van den Akker, 1995:45; Chisholm, 2000: vi - vii).

Van den Akker (1995:46) reported that Stuart characterised his findings about science teaching classroom practices in Lesotho as follows:

- Most teaching was formal and didactic: question, answer and teacher exposition: teachers did most talking (85%), and pupils contributed only 15% by answering questions.
- Pupils asked questions seldomly; and rarely did they even initiate an exchange of thoughts.
- Questions were based mostly on recall and comprehension, and seldom at comparing, inferring, reasoning and evaluating.
- No models of higher cognitive skills were present in the teachers' lectures.
- Very little practical work occurred, often because of lack of equipment or time.

In Malaysia, it has been reported that the transition rate into science at senior secondary level dropped from 20 to 15 per cent between 1985 and 1990, and in Morocco from 23 per cent to 18 per cent. Interviews with science teachers, students and counsellors were carried out in Malaysia, and it was revealed that a lack of interest in science and a lack of confidence in performing well in science were the contributing factors which most led to the rejection of science and to the requests for transfers from science to other options (Calloids *et al.*, 1997:101).

Many of the issues discussed above might also be factors contributing to the decline of science education in Lesotho in recent years.

1.4 A theoretical/conceptual model for science education curriculum development issues

Solomon (1998) has described a comprehensive theory of the multiple contents of the public understanding of science. This investigation situates its study of issues of science curriculum improvement in the larger context of Solomon's (1998) conceptual framework for a model of science education policy. In her paper "The development of life skills through science and technology education for the 21st century", Solomon looks beyond the content of the school science curriculum, and beyond practical work in school laboratories. Among other things, she highlights the wider importance of science in everyday life and in social settings. She moves the context of learning science into the home; she engages economics and science; and she links the learning of science with the employment of trained technical experts in the labour market and vocational and core communication skills to prepare pupils for relevant careers needed by industrialists in a diversity of linguistic and cultural traditions. Finally, she focuses on science for the development of the individual pupil, encouraging the growth of independent learning skills such as creativity and curiosity.

The components comprising Solomon's (1998) conceptual model for improving the teaching and learning of science may be summarised as follows:

- Science for the personal development of the individual
  - a) by enhancing his/her life skills
  - b) by enhancing his/her vocational skills
  - c) by enhancing his/her communication skills
  - d) by enhancing his/her citizenship skills
  - e) by enhancing his/her long-term values
  - f) by enhancing his/her personal growth
  - g) by enhancing his/her creativity skills
- Science as a requirement of a specific requirement or vocational board body
- Science for its own rational development
  - a) as a logically structured set of concepts, theories, processes, skills, evidence, knowledge and limitations
  - b) as a development of historical events
- The humanistic utility of science
  - a) for societies' needs
  - b) for the economic development of a nation with a specific reference to
    - i better health

ii the environment

iii social reconstruction

iv science for the work place

v ethical dilemmas

vi the international future competitive edge

vii mobilization for informed, motivated and substantive social change

viii cultural transmission of knowledge

ix adaptable, novel retraining of the workforce

1.5 Importance of the research problem.

This study is of importance because De Feiter (1995) reported that, in BoLeSwa (= Botswana, Lesotho and Swaziland) countries, participation in different secondary school subjects seemed to vary a great deal, especially in the sciences. In Botswana about 20% of senior high school students took three separate sciences, unlike in Lesotho and Swaziland where biology was taken as a separate subject. In Lesotho and Swaziland, the school subject Human and Social Biology was treated as an option for the least scientifically inclined. The survey stated that achievement greatly increased when more students took science combination subjects in Botswana, i.e. many more students obtained good passes. In Lesotho, on the other hand, the pass rates were found to remain very low in all subjects, while in Swaziland the biggest problems appeared in Biology (p.37).

A recent study in Lesotho revealed that achievement in science education was not yet very impressive, and so the number of qualified people in science is still below the demand of the country. Even though the relevant statistical data were not given, there appeared to be a need for the country to increase significantly the number of trained people in science to try to cope with the situation (Talukdar, 1996a:24).

In the light of the situation described above, the National Curriculum Development Centre aimed to revise school curriculum materials and syllabuses to focus on the following aspects:-

- There should be linkages between primary, secondary and tertiary levels;
- In Forms A and B, emphasis should be on mastery of English; and
- Practical studies should be introduced to foster self reliance, etc. (Ministry of Education, Lesotho Secondary Education Policy , 1995:5).

The country has to identify clearly the classroom constraints of its science education and make realistic efforts to remedy them. Thus, there is also a need for a study to be undertaken *in situ* or "on the ground", the respondent groups being Lesotho science teachers and their students, for testing the feasibility, acceptance and relative importance of such policies.

1.6 The purpose of the study

The aims of the current research are:-

- To determine the areas of agreement of Sesotho-speaking high school science teachers, Sesotho-speaking primary school science teachers and Sesotho-speaking senior high school students on 20 suggested literature-derived policy recommendations for making future improvements to school science teaching, learning and curriculum.
- To explain any significant areas of agreement/disagreement that might occur among the response trends of the three samples, using qualitative follow-up studies.
- To establish whether there are any statistically significant differences among the samples with regard to their choices of "*most important*" policy recommendations.
- To establish whether there are any statistically significant differences among the samples with regard to their choices of "*least important*" policy recommendations.
- To discover and make additional recommendations for adapting the existing data gathering instrument to the needs of present and future science teachers and their students in an even wider variety of Lesotho contexts.

1.7 Hypotheses

In the present study, six null hypotheses were tested on the data supplied by the three samples: 94 Lesotho high school science teachers (sample 1), 77 Lesotho primary science teachers (sample 2) and 368 Lesotho high school students (sample 3):-

Ho1a There will be no significant difference between the responses of sample 1 and sample 2 in their frequencies of their agreement / disagreement with each one of the 20 proposed science policy recommendations.

Ho1 b There will be no significant difference between the responses of sample 1 and sample 2 in their frequencies of their best/least important priorities for each one of the 20 proposed science policy recommendations.

Ho2 a There will be no significant difference between the responses of sample 1 and sample 3 in the frequencies of agreement/disagreement with each one of the 20 proposed science policy recommendations.

Ho2b There will be no significant difference between the responses of sample 1 and sample 3 in their frequency of best /least important choices for each one of the 20 proposed science policy recommendations.

Ho3a There will be no significant difference between the responses of sample 2 and sample 3 in their frequencies of agreement/ disagreement with each one of the 20 proposed science policy recommendations.

Ho3b There will be no significant difference between the responses of sample 2 and sample 3 in their frequencies of their best choice or their least important priority for each one of the 20 proposed policy recommendations.

1.8 Clarification of terms

1. In this study **Science** means the subjects "biology, chemistry, chemistry/biology, combined science, human and social biology, physics, physics/biology, physics/chemistry, junior science" as taught in Lesotho schools.
2. **Sesotho** is the official language of Lesotho and it is also one of South Africa's official languages.
3. **Basotho** - people of Lesotho

1.9 Limitations of the study

The study is limited to a convenient cluster sampling of Lesotho high school science teachers (sample 1), Lesotho primary science teachers (sample 2) and Lesotho high school students (sample 3) in 1999. Only the most important twenty curriculum policy suggestions have been evaluated in this study.

1.10 Assumptions of the study

The study assumes that all the science education respondents are reasonably well informed and are interested in making their own decisions on:-

- the suitability of the twenty suggested science education policy recommendations presented in English;
- their choices of two best and two least important policy recommendations; and
- suggesting more policy recommendations to be included in the new science curriculum and in new science education practice.

1.11 Research approach

The survey research method has been used to collect the data. A literature-derived and refined 20-item data-gathering instrument has been adapted and expanded for Lesotho from the work of Solomon (1998) and Sokopo (1998), and subsequently employed. The response data from 94 Sesotho-speaking bilingual high school science teachers has been collected personally by the researcher with the help of her sister, and response data from 77 Sesotho-speaking bilingual primary science teachers was again collected personally by the researcher with the help of her sisters-in-law and class heads. Response data from the 368 Sesotho-speaking bilingual senior high school students was collected through heads of science departments. Chi-square tests and correlations have been used to analyse and compare the patterns of quantitative responses in the data. In addition, more than 700 qualitative responses, and suggestions, explanations and recommendations provided by the respondents in reasonable English have been categorised, summarised and presented, to justify and account for the quantitative findings.

1.12 Organisation of the remainder of the dissertation

The next five chapters are arranged as follows:-

Chapter 2 elaborates on the theoretical background of the problem, and it summarises the current science education literature which places the present problem in context.

Chapter 3 describes the research methodology in detail.

Chapter 4 consists of the presentation of the quantitative results and a summary of the qualitative results.

Chapter 5 discusses the empirical research findings and the qualitative results; and the implications which they might have for improving the Lesotho science curriculum, teaching and learning .

Chapter 6 formulates recommendations for further research, and presents the conclusions to the investigation.

1.13 Chapter summary

In this introductory chapter, the research problem has been formulated, and its setting, origin, context, purpose, background and significance stated. The aims and objectives of the research have been given, and the reasons for conducting the study, the limitations of the investigation, the assumptions, the hypotheses, and the key terms have been clarified. The research methodology of the study has been introduced, describing the intended data-gathering procedures, the respondent samples, the instrument, and the proposed methods of analysis.

The next chapter develops the theoretical framework of this research in detail. Then it presents a synthesis of the current science education research literature in which the Lesotho study is itself situated. Finally it shows how this 1999 research in Lesotho will make its own contribution to filling some of the gaps which currently exist in the published science education research literature.

CHAPTER 2

LITERATURE REVIEW

This chapter is divided into Part A - Context, and Part B - The literature derived instrument.

PART A : THE CONTEXT OF THE STUDY IN REVIEW

In Section 2.1, a brief overview is presented of the recent and current status of school science and technology education in Lesotho. Section 2.2 reviews the recent trends in science and technology education in different countries, to provide the wider context in which the present investigation is situated.

2.1 The current status of school science and technology education in Lesotho.

2.1.1 The national status of science education in Lesotho

Science is a compulsory subject from primary level to the junior level, and is optional at the senior level. It is not a failing subject at any level. Although the sciences are compulsory at the lower level, laboratory facilities are seriously lacking in Lesotho schools, and the situation is even worse at primary schools as some schools do not even have laboratories, and to a lesser extent at high schools.

McMurchy (1997:3) reported that the poor quality of primary education in Lesotho has been a prevalent factor contributing to deteriorating secondary school pass rates. Students entering form A are often under-prepared for the demands of the Junior Certificate (JC) and Cambridge Overseas School Certificate (COSC) programmes. At the primary school level there is no separate teacher for science instruction because primary teachers do not specialise.

Recent problems facing science education in Lesotho have been summarised by McMurchy (1997:3) and Talukdar (1995a:3) :-

1. There is a severe overcrowding in primary schools, with the average student : teacher ratio being 55:1.
2. Twenty percent of primary teachers are underqualified.
3. There is little in-service training for teachers, and its supervision by the Ministry of Education (MOE) is inadequate.
4. Shortages of resources are widespread.
5. Teachers' and pupils' attitudes towards work is complacent.
6. There is a shortage of locally produced textbooks.
7. Weaknesses in English and in Mathematics are most noticeable.
8. Inefficient management and administration of schools are common.

Furthermore Talukdar (1996b:9) states that many non-science teachers have attempted to teach science in the Lesotho school system. He points out that 200 secondary and high schools require at least 1000 additional teachers to teach science adequately.

Most schools are understaffed in all subjects, but especially in science. The main body of science teaching staff is composed of nongraduate science teachers. The country's only university is capable of producing a mere 20 to 30 science teachers annually, supplemented by the NTTC (National Teachers' Training College) which prepared a small number of science teachers and 25 agriculture teachers annually. Most of these are mainly prepared to teach science at the junior level. The situation is aggravated by a significant proportion of newly qualified science teachers finding employment across the Lesotho border, or travelling abroad to further their studies in response to teachers' complaints about low wages in Lesotho.

Student performance is another general concern raised by the teachers surveyed (McMurchy, 1997:5). These teachers are also under the impression that secondary education standards are deteriorating, and that change is necessary in the secondary programme. More than 50% of the teachers surveyed claim that an irrelevant curriculum and students' attitudes are the major causes of academic underachievement. Other possible causes identified are: inadequate English language skills, under-qualified teachers, inefficient primary preparation, lack of continuity between JC (Junior Certificate) and COSC (Cambridge Overseas School Certificate) curricula, under-resourced facilities, lack of parental support and involvement, and burdensome syllabi. In short, teachers feel that school education is not responding to the needs of the majority of the students in attendance. As a result, there is a need for a proposal to gear the curriculum programme towards those students who would complete their schooling and find themselves in the work force after secondary school.

On the other hand, parents are of the view that secondary schools should have a crucial role to play in the students' all-round employment. They want high school education to be designed in such a way that their children would be provided with an academic and professional education, and moral awareness; would learn how to be valuable members of society; and would realise the importance of education. They also want career guidance to be offered in schools. Both parents and teachers complain that students lack the spirit of learning, which might be caused by a failure in motivation resulting from students not seeing the relevance of education (McMurchy 1997: 5).

In his research, McMurchy also found that more than 50% of the responding students replied that they needed more instruction in life skills. Further 25% of the students also indicated that their studies should be directed more towards their prospective careers (p.5).

Commenting on the findings, McMurchy (1997:6) concluded by saying that, due to the claims of poor motivation of students, it appears as if students do not see the direct correlation between their studies and their future. As a result they tend not to appreciate the value of secondary education. They wonder in what concrete way the material covered at school will benefit them in finding jobs and support themselves and their families after they have completed.

To give a brief overview of the trend of performance in the sciences, an examination of the students' results in the years 1995 - 1997 (COSC) Cambridge Overseas School

Certificate (Table 2.1 on page 24) indicates the performance of school candidates in science subjects. It can be observed that there is high percentage pass in combined science, whereas the performance seems to be declining in chemistry. The performance in science was not really declining, as the media claimed in the country, but there was a slight improvement in some of the science subjects, i.e. biology, chemistry/biology and physics/chemistry. Furthermore, physics recorded only a 12% pass in 1995, and it increased to 25% the following year, but in 1997 no candidates sat for it. Physics/biology obtained a 9.7% pass in 1995, no candidates sat for it in 1996, and in 1997 the percentage pass increased to 40%. However, in some cases, the performance was fluctuating, e.g. in human and social biology and biology.

Table 2.1
Cambridge Overseas School Certificate Examination Results for School Candidates by Subject: 1995-1997

YEAR	Subject:	Results: A	B	C	D	E	U	Number who sat	Number who Passed	Percent Passed
1995	Biology	16	104	232	202	317	1393	2264	871	38.5
	Chemistry	-	-	-	3	2	19	24	5	20.8
	Chemistry/Biology	10	30	52	102	138	328	660	332	50.3
	Combined Science	24	73	79	105	120	63	464	401	86.4
	Human & Social Biology	7	49	111	116	210	347	840	493	58.7
	Physics	-	1	-	-	2	22	25	3	12.0
	Physics/Biology	-	-	2	1	-	28	31	3	9.7
	Physics/Chemistry	71	101	168	215	283	679	1517	838	55.2
1996	Biology	14	142	328	297	400	1325	2506	1181	47.1
	Chemistry	1	-	-	1	5	72	79	7	8.9
	Chemistry/Biology	10	40	83	144	184	378	839	461	54.9
	Combined Science	34	101	96	107	102	67	507	440	86.8
	Human & Social Biology	18	67	195	143	143	139	705	566	80.3
	Physics	-	-	-	-	6	18	24	6	25.0
	Physics/Biology	-	-	-	-	-	-	-	-	-
	Physics/Chemistry	22	112	169	267	318	648	1536	888	57.8
1997	Biology	16	89	276	293	341	1476	2491	1015	40.7
	Chemistry	-	-	-	1	1	29	31	2	6.5
	Chemistry/Biology	3	46	95	138	259	311	852	541	63.5
	Combined Science	55	108	161	162	136	83	705	622	88.2
	Human & Social Biology	12	61	123	107	225	664	1192	528	44.3
	Physics	-	-	-	-	-	-	-	-	-
	Physics/Biology	-	-	1	1	-	3	5	2	40.0
	Physics/Chemistry	31	123	224	320	397	494	1589	1095	68.9

(Source: Education Statistics, Ministry of Education, 1995, 1996, 1997: 83, Table 63).

2.2 Major goals of science education in other countries

A few introductory examples of current trends may be mentioned, before setting out a more detailed analysis in section 2.3. (Italics are used by the present writer to focus on relevant, internationally current issues which were subsequently incorporated into the writer's data-gathering questionnaire.)

2.2.1 China

According to Gao (1998:2), the Chinese society considers education as necessary and important for governing and ruling. Therefore, the Chinese place more emphasis on the following goals :-

1. Developing student's *skills*, *abilities*, and *scientific literacy*.
2. Training *socialist* citizens.
3. Improving the quality of the entire nation.
4. Developing student's skills in *observing*, *experimenting* and *thinking*.
5. Mastering scientific methods *step by step*.
6. Setting up good *attitudes* towards both learning and science.

2.2.2 Europe

Bybee & DeBoer (1994:360) stated that, even during the nineteenth century, European educators placed emphasis on the following aspects:-

1. Encouraging a *child-centred approach*.

2. Encouraging *independent thought.*

3. Considering sense impressions as the basis of knowledge.

4. Practising an *active role* rather than a passive role for the learners.

2.2.3 Asian American schools

Lee (1997:107) presented the following goals for science education in Asian American schools:-

1. Engaging students in scientific enquiry by formulating questions, proposing hypotheses, manipulating materials, describing objects and events, *experimenting* with variables, gathering data, verifying evidence, making inferences, constructing explanations, and drawing conclusions.
2. Practising *hands-on* approaches and use of concrete materials.
3. Encouraging *co-operative learning* which reflects the collaborative practices of the scientific community.
4. Discussing science in its *social context.*

2.2.4 Spain

According to Membiela (1999:72) the science curriculum in Spain puts more emphasis on :-

1. Making science education interesting and *useful.*
2. Integrating *environmental* education, *health* and consumer education into science education.

3. Orientating science education towards action and towards *social responsibility*.

2.2.5 Indonesia

According to Thair & Treagust (1999:358), *practical* activities play an important role in secondary education in that they attribute the following outcomes:-

(a) Reinforcement of the understanding of scientific concepts and principles ;

(b) Involvement in a number of handling and measuring skills and therefore promotion of the development of *practical skills* in students; and

(c) Involvement in *problem solving* and a "thinking style" that exposes students to the way of " working like a scientist".

Although many of these sample goals and purposes of science education overlap, a total of twenty strong suggestions relevant to conditions in Lesotho were derived from a more comprehensive review of the science education research literature, and these are now synthesised coherently and presented in Part B, below.

PART B: THE LITERATURE-DERIVED INSTRUMENT

This section records how the wording of the 20 items comprising the survey instrument came from the literature review which focused on recent and current policy recommendations for improving Lesotho school science education in its Southern African context.

2.3 The 20 items and the theoretical basis for their selection

Item 1

*"**Introducing more real life skills in science education** (such as technical, trade, industrial, commercial, farming, mining, manufacturing, marketing and technological skills.)"*

In the Ministry of Education's 1991/92-1995/96 Development Plan (p. 48) it is envisaged that considerable effort would be put into integrating practical skills relevant to everyday life in the primary school curriculum.

Carbone (1999:58-59) stated that good learning includes making links between items of knowledge and the real world. This is essential to develop basic understandings for students to make their own connections and analogies.Van den Akker (1995:42) supported this statement, emphasising that science instruction should be made more meaningful for the learners. There should be less transmission of 'abstract theory'. In other words, science should be related to the natural and social context and to pupils' everyday life experiences. He also strongly recommended that the relevance of science should be emphasised through greater consideration of the application of scientific principles to everyday life, technology, the production of food and the conservation of the environment (p.43).

Balogun (1997:2) emphasised that the intellectual functions of science education incorporate the development of knowledge and understanding of the world around us; the environment and its control; the structure of society; the heritage from the past and of the present; acquisition of scientific vocabulary; and processes of inclusive thought. He further pointed out that a good science education provides children with the ability to know more about nutrition, health, family planning, etc. In turn this will help children to cope more intelligently and effectively in their everyday life, and be prepared for jobs; for example, in agriculture, architecture, the biological sciences and technology.

Dlamini *et al.* (1999:144) reported that empirical studies show that the use of everyday contexts in science teaching improves learners' motivation and engagement with learning. Furthermore, he argued that, to explain natural phenomena, examples from the learners' surroundings need to be prioritised. However, the most frequent argument for contextualising science teaching is the illustration it provides for applicability and usefulness.

<u>Item 2</u>

*" **Paying more attention to gender issues in science** (such as men and women in science, topics that cater for girls' and boys' interests, solutions to the existing gender problems in Lesotho)."*

The report of the national seminar on Lesotho Secondary Education Policy, Ministry of Education (1995:22) noted the importance of Sesotho culture and how it can influence gender issues in the choice of subjects at secondary school level, e.g. agriculture for boys and home economics for girls. The seminar recommended that the choice of subjects at secondary school level should not be gender biased and that gender equity must be addressed in the secondary education policy.

<u>Item 3</u>

*"**Concentrating more on Lesotho environmental issues** (e.g. problems of soil loss and possible solutions, health care, sanitation, air pollution, electricity supply, conservation of plant and animal species, etc.)"*

The report of the national seminar on Lesotho Secondary Education Policy, Ministry of Education (1995:22) emphasised that secondary education should also provide students with the relevant skills for employment opportunities that would be available in the country, e.g. at the Lesotho Highlands Water Project.

> "The creative aspects of technology have sometimes been downgraded and not given sufficient attention in education.... The need to 'mend the Earth' could to a large extent be satisfied if we applied the methodology of technology to it...." (Baez 1991:136).

Item 4

***"Using science to advance and develop the Lesotho community socially and economically** (i.e. to help solve political, labour, citizenship, social and ethical problems in Lesotho society.)"*

Talukdar (1996a:36) stated that it is the government's priority to see to it that education is relevant to the manpower needs of the country by producing sufficient numbers of people with appropriate occupational, technical and managerial skills to ensure the development of the modern sector of the economy. The 1990/91-1994/95 Development Plan clearly emphasised that this could be achieved by having closer links with the industries and employers, through promoting technical subjects at secondary school level and developing a national curriculum for post-secondary institutions.

The Ministry of Education's 1991/92-1995/96 Education Sector Development Plan raised a concern that it seems as if there is inadequate basic education in primary school which leads to long term consequences for Lesotho's economic and social development. Although 20,000 people enter the work force each year in Lesotho, approximately 6,000 people find jobs and those unemployed are unable to find jobs because of low level of skills.

Thrulstrup (1999:10) & Helms (1998:644) maintained that there was evidence from several countries that weak or defective science and technology education at primary level had a negative effect on the motivation of students, especially girls, for later careers in science and technology fields such as engineering. He further pointed out that there should be political decisions of a science-based nature (e.g. dealing with energy, environment, health, etc.) in both developing and industrialised countries, and that these decisions can only be made on the basis of a sufficient scientific insight among politicians as well as voters.

Item 5

"Paying more attention to language issues *(such as technical terms; using the mother-tongue (Sesotho) to give instruction; cultural meanings of scientific words; learning to understand terms and language; scientific English as a second language; etc.)* "

Talukdar (1995a:5) emphasised that one of the unfortunate educational problems for the children of Lesotho is that they have to study at schools in a foreign language. Consequently, children have to give more efforts to learning the language rather than understanding the subject. This takes much of their time and energy. Furthermore, there are numerous scientific concepts in English which do not have the exact equivalent in a local language; therefore it is the task of the teacher to ensure that pupils learn the correct meaning of concepts. Although English is a medium of instruction in Lesotho from the primary level, the language ability of pupils is poor.

Rutherford (1993:285) stated that second language speakers are faced with a problem because they frequently try to translate into the vernacular with confusing results. Cleghorn, *et al.* (1989:21) also maintained that when teachers try to search for English equivalents of what is familiar, but not conceptually the same, in the local language, then the actual meaning of what is to be taught can be altered. The manner in which language is actually used during instruction is very important for understanding educational outcomes in a multilingual, developing country. Rutherford, *et al.* (1999:373) highlighted that, in some cases, words might have different meanings in different subjects. For example, the word 'cell' can be defined as a unit of an organism in biology and as part of an electrical battery in chemistry, whereas in English it can be described as a small room where a monk lives. They further pointed out that meaning is carried by the context, although teachers may not always make it clear that in a particular instance the context has changed. The connection between the different meanings is often clear but these tend to be potentially confusing words for students.

Dzama & Osborne (1999:389) stated that the students' mother tongue facilitated students' learning of science concepts. They further stated that there is evidence that learning science in a foreign language does create additional problems for learners.

However the evidence is not entirely consistent on the use of 'mother-tongue' instruction. For example, in a Malaysian study, it was found that problems with the use of 'coined' words for scientific concepts caused some problems when attempting to teach science subjects through the mother-tongue (Rollnick & Rutherford, 1996:92).

Item 6

" ***Having the underprivileged majority as its focal point.*** *(Using science education to empower Lesotho communities to address their local problems resourcefully.)*"

The report of the national seminar on Lesotho Secondary Education Policy, Ministry of Education (1995:23) recommended that learners should be encouraged to have a spirit of co-operation with, and service to, the underprivileged members of their communities, and to discourage a feeling of superiority.

Knuth *et al*. (1991:4) emphasised that the community can provide a rich source of opportunities for children to learn science; and, again, the members of the community are a rich source for the students in the ways that they use scientific thinking in their occupations. Furthermore, research suggests that all groups can succeed in science when given equal access. Thus, it is necessary to remove obstacles and to provide mechanisms for children to become scientifically literate (p.5). In addition, underprivileged students should be given opportunities to provide community services such as surveys, newsletters, plays and tutoring; to participate in community affairs; to promote school and community forums; to debate the national education goals; and to be engaged in learning out of school with community members. Again, teachers and other school staff should not be denied access to discuss the life of the school, resources, and other areas vital to learning. They further pointed out that the condition necessary for improvement in science education is the involvement of administrators, university faculty members, community, business, labor, and political leaders, as well as teachers, parents and students (pp.5-9).

Item 7

" ***Encouraging more competitions in science*** *(with more enterprises to be organised between schools in Lesotho and within schools, such as science quizzes.)"*

Bochinski (1991:416) highlighted that one of the most important aspects of science fairs is that they give a student educational opportunities for exchanging and learning new scientific methods and concepts with professionals and other contestants. Again, a science project gives the participant an opportunity to gain hands-on experience and knowledge in an independent field of study. It is a challenging extracurricular assignment that allows a student to use his/her own ideas on a topic.

Biehler & Snowman (1997:416) pointed out that some researchers have argued that competitive reward structures lead students to focus on ability as the primary basis for motivation. Thus, when ability is considered to be the basis for motivation, competing successfully in the classroom may be seen as relevant to self-esteem, difficult to accomplish, and uncertain. These perceptions may cause some students to avoid challenging subjects or tasks, to give up in the face of difficulty, to reward themselves only if they win a competition, and to believe that their own successes are due to ability, while the successes of others are due to luck.

<u>Item 8</u>

" ***Making more use of self-discovery and self-teaching*** *(i.e. students designing more of their own experiments and field work, and developing skills of problem solving, creativity, thinking, etc.)"*

Talukdar (1995b:53) stated that teachers are of the opinion that pupils are passive recipients of knowledge delivered by teachers, and even experts confirmed this situation, but they blamed teachers for not being able to involve pupils in the instructional process.

Prain & Hand (1996:117) suggested that, as part of active learning in science education, students need to be given opportunities to articulate, defend and explain their ideas within the social context of the classroom. Students need to refine understandings through 'open-ended questions, creative writing, explanations and classroom dialogue'. Watters & English (1995:699) also supported this idea by suggesting that if students could be given a chance to think logically, reflect on experiences, and justify their reasoning, then more effective learning may occur.

Stohr-Hunt (1996:101) & Lock (1998:633) concluded that students who were engaged in hands-on activities every day or once a week, scored significantly higher on a standardised test of science achievement than students who were engaged in hands-on activities once a month, less than once a month, or never. Carbone (1999:57) stated that active engagement and not passive reception characterises quality learning and highlighted that student's interest can be maintained and generated through engagement, challenge, coherence, variety, perceived mastery and students should have a feeling that they have made some contributions in the teaching and learning process. Students realise that whenever they sit in silence, these periods of silence cause their teachers to give out answers, not realising the consequences of this behaviour on their learning.

Item 9

"***Changing the science curriculum to a core syllabus plus many options**, (which students could choose freely and individually for their own personal relevance and pleasure, and making the syllabi more compatible with the needs of tertiary institutions in Lesotho.)"*

The Report of the national seminar on Lesotho secondary education policy, Ministry of Education (1995:4) suggested that secondary education should lay great emphasis on the necessary linkage between primary and secondary and tertiary levels. Again there is a need for the type of curriculum which is relevant to students' lives. Furthermore, students should be given an opportunity to achieve the full development of their talents by providing options for specialisation (p.23).

Item 10

" ***Giving all pupils in Lesotho primary schools much more basic science*** *(giving primary school pupils much more science education than they are learning at present, i.e. before they come to high schools.)*"

Talukdar (1996a:21) stated that broad aims of teaching primary science are: to ensure a sound foundation of basic scientific principles and facts in those who may later seek to make a career as scientists; to promote scientific literacy; and, lastly, to develop scientific attitudes among the pupils i.e. willingness to accept criticism, co-operativeness, competitiveness, objectivity and curiosity. Thrulstrup (1999:12) also maintained that there is a need to strengthen primary school science and the related teacher training, as this might have a long lasting effect.

Woodward & Woodward (1998:44) emphasised the importance of the junior years, because ages 8-13/14 years are the critical years for the formation of children's attitudes to science. They also pointed out that there is a need to consider the primary years and the image of science and scientists portrayed at this stage, and they claim that early experiences of science in the home and in school can influence pupils to 'switch onto' science and technology. Then they concluded that what goes on in the primary school is fundamental to pupils' subsequent involvement and interest in science.

Item 11

" ***All interested groups in the Lesotho communities should be consulted*** *(community consultations should be made on how science can be improved in high schools by the year 2000.)"*

Knuth *et al.* (1991:9) emphasised that active involvement of community members on task forces for curriculum, staff development, assessment, etc. are vital to learning. Royal & Rossi (1999:259) suggested that experiencing a sense of community at work may benefit teachers personally and hence advance their instructional efforts.

Item 12

" ***Using computer-aided instruction and computer interfacing as part of science experiments in Lesotho*** *(e.g. to collect, display, combine, analyse and plot data.)"*

There is much evidence that computers have positive effects on cognitive learning outcomes in science and that they are interactive tools affecting the social processes within the classroom in terms of culture, learning conditions as well as students' and teachers' goals. Learning was shown to have improved in a number of science skills, such as reading data and interpreting graphs, manipulating variables, constructing hypotheses, ability to conduct experiments, generate creative questions, draw conclusions and think critically (Levine & Donitsa-Schmidt, 1996:163). The afore-mentioned authors then concluded that the classroom environment may be altered by the incorporation of computers into science learning and instruction.

Huppert *et al.* (1998:231) stated that computer-assisted learning can be practised to raise the quality of the laboratory work to a higher cognitive level and to substitute for shortage of time and equipment. Computers enable students to be actively involved in the learning process, individually or in groups of two or three, and they allow students to progress at their own pace, whether gifted or low achievers.

Item 13

"Promoting careers and job prospects in science among school pupils in Lesotho".

Caillods *et al.* (1997:82) highlighted that science and technology graduates are primarily employed in the public sectors, i.e. public administration and para-statals, with the Ministry of Education being the biggest employer of science-trained graduates. Thus, employment opportunities for science graduates rely much on job openings in the public sector, which in turn are linked to the fluctuations in the recruitment of teachers. Therefore, it is suggested that planners should indeed take into consideration the salary structures because, if there are no income advantages to studying science, or the prospects of being employed are no better than for others, then this might imply several possibilities which carefully need to be attended to.

Item 14

***"Sharing and increasing the intellectual excitement and sense of adventure which science offers** (its hope, benefits, optimism, encouragement, spirit and challenge in Lesotho.)"*

Yager (1993: 43-65) suggested that science/technology/society classrooms should put emphasis upon career awareness and more specifically on those careers related to science and technology. Furthermore he tried to identify ways that science and technology are likely to impact the future, and students be actively involved in seeking information that can be applied to solve real-life problems, and emphasis be put upon skills which students can use in resolving their own problems.

Jenkins (1992:232) also observed:

> " If school science is to nourish the intellectual excitement and adventure that science undoubtedly offers, it must do so in a context that acknowledges that pupils are growing up in a world...."

Item 15

*"**Acquiring more resources for schools in Lesotho** (i.e. libraries, library books, laboratories, science equipment, computers, etc.)"*

Talukdar (1995a:3) emphasised that the success of teaching and learning science depends to a large extent on the proper use of resources. He stated that laboratory facilities were seriously lacking in Lesotho schools, and the laboratories were either empty or poorly organised. The equipment and materials are poorly stored and the schools did not have a developed system of maintaining laboratory facilities at a reasonable level. Talukdar (1995b:108) stated that textbooks were the common source of information and very useful for classroom instruction. Even today, textbooks, laboratories, audio-visual aids, etc. are important facilities for teaching and learning science which are said to be poorly provided in the schools of Lesotho. The Education Sector Plan, Ministry of Education (1991/92-1995/96:25) highlighted that the secondary school sector is better off compared to the primary school sector in terms of facilities.

Appleton & Kindt (1999:155) raise the concern that lack of resources could result in a topic not being taught, or could determine how a certain topic is taught, or could determine the actual activities children engaged in. Even if resources are available in the school, they become ineffective if they are poorly organised.

Item 16

*" **Conducting science campaigns** (i.e. raising people's awareness about the benefits of science for Lesotho and offering more bursaries and scholarships for students to study science)."*

This item was included because of recent personal communications from colleagues and students in Lesotho who were advocating and urging them in 1999.

Item 17

*" **Having more extramural science activities** (in the form of science excursions, fieldwork, more practical work, science clubs, projects, etc.)"*

This item was also included because of personal communications and recommendations from colleagues and students in Lesotho.

Item 18

*" **Having external support and recognition for science students** (encouragement from parents; and putting personal monetary awards at various levels of science education in Lesotho.)"*

Research has shown that parental involvement in students' academic lives is one of the most important variables which contributes to promoting student achievement (Rochford, *et al.*, 1997: 175) and Desimone (1999:11). There is clear evidence that family encouragement as well as family interest in schools and classrooms affect children's achievement, attitude, and aspirations. Teachers do agree that parental involvement can increase their effectiveness and children's success in school, and that this could even encourage teachers to do better (Smith & Hausufus, 1998:111-125).

Item 19

" ***Having better teaching methods*** *(good science teaching methods are those which promote interest in the study of the physical and natural world and society; and which encourage the practical aspect of the subject.)"*

Carbone (1999:58) states that good teaching is teaching which is likely to result in high quality student learning. He further highlights that good teaching can be tested by whether it is helping students to learn. Good teaching includes a broad range of interactions between students and staff, e.g. through printed or electronic material, or face-to-face situations, or other media. Good teaching further implies a professional approach combining continuous reflection and improvement. Good researchers are said to be attentive to the methodologies they use. They respect relevant evidence and strive to sharpen their skills. Similarly, good teachers would always strive to be attentive to the learning-teaching process, and try to find means and ways of making it better.

Item 20

" Science as an entry requirement *(making science an entry requirement to all science-oriented study at tertiary institutions; and at least one science subject as an entry requirement to non-science tertiary institutions.)"*

This item was included because of urgent personal communications from many colleagues and insistent students in Lesotho.

2.4 Chapter summary

This chapter comprised two sections - Part A and Part B.

In Part A, the following were discussed:-

In section 2.1, a brief overview of the national status of science education in Lesotho was presented.

Section 2.2 outlined major goals of science education in other countries.

Part B recorded the 20 items together with a brief overview of the theoretical and literature-derived bases for their selection. The chapter which follows presents the research methodology.

CHAPTER 3

RESEARCH METHODOLOGY

The methodological aspects described in this chapter are:

3.1 The development of the instrument.

3.2 The survey research method.

3.3 Discussion and critique of the research method

3.4 The samples and their contexts.

3.5 Procedures for data collection .

3.6 Interviews.

3.7 Data capture and analysis.

3.8 Selection of statistical methods.

3.9 Chapter summary.

3.1 Development of the instrument

3.1.1 A history of the formulation, compilation, development and validation of the final instrument from 1995 to 1999

Developmental pilot studies of a series of potential instruments (Appendix 2) began at the university of Cape Town in 1995 using critical research groups of post-graduate science and technology teachers in small scale trials. In the first attempt at piloting an instrument, the respondents were asked to rank the items in order of importance, but this procedure required re-wording. The most practical outcome which emerged from the piloting was the suggestion to make just a simple headcount of all the 'agree' or 'disagree' responses for each item (Sokopo 1998:35), supplemented by qualitative written responses from participants in the survey justifying their choices.

After trialing at three Universities in South Africa, fifteen categories of policy recommendations emerged, and these were carefully worded and selected as being immediately relevant to South African science-engineering-technology education, and to the principles and values stated in the Government White Paper (RSA, 1995).

These statements of recommendations were then amplified and used from 1995 to 1997 to develop the content of a survey instrument comprising seventeen items, in order to gather data for science-technology-society policy formulation and prioritisation as part of the new RSA Government of National Unity's Reconstruction and Development Programme. The statements were amplified to give more clarification to their meaning so as to eliminate or reduce ambiguity.

Further recommendations were received during the testing of the instrument, and these led to the inclusion of an open-ended section in 1997 (Appendix 2). Respondents were invited to give reasons of their choices of 'best/least' important recommendations, and to offer any other suggestions which they felt might have been omitted from the instrument.

Finally, in 1999 an expanded form of the stable instrument was adapted and validated to be used for the collection of data in Lesotho by substituting 'North West Province' with 'Lesotho' (Appendix 3b) where appropriate. In 1999 six more items, with specific reference to Lesotho science education, were added.

3.1.2 The reliability of a developed form of the instrument

The reliability of the responses to a piloted version of the instrument comprising items 1 to 14 was initially measured using an intact sample of volunteer science/technology teachers over a period of seven weeks. Test/re-test responses yielded reliability coefficients (see Ebel, 1972:418) of r=0.97, r=0.88 and r=0.90 (N=14). Secondly, the assessment of the reliability of the items 1 to 14 in the instrument and the stability of the responses was also made in 1997 using an intact class of grade 11 science pupils whose home language is Xhosa over a period of seven days. Test/re-test scores yielded reliability coefficients of r=0.91 and r=0.90 (N=47) for the Xhosa version of the instrument (see Appendix 3d) (Sokopo 1997: 36). In 1999, test/re-test reliabilities of the instrument using the first 20 items were found to be from r= 0.95 to r= 0.97, using a convenient sample of N= 10 adult respondents in education over a period of two weeks.

3.1.3 Questionnaire design and development

The literature was consulted for the questionnaire design. Technical directives, checks and balances offered by survey research questionnaire practitioners Cohen & Manion (1985), and Wiersma (1991) were used. Throughout the piloting of the wording of the final survey more attention was paid to the following:-

1. Readability - simplicity in the use of vocabulary.
2. Clear and concise instructions.
3. Length of the questionnaire - compact, but with explanatory details.
4. Layout - compact, with focused sub-headings.
5. Clarity of the statements - using examples in italics where necessary.
6. Elimination of apparent duplication of words in some items.

The piloting of the wording of the trial versions of the questionnaires concentrated on asking critics to circle, in red, all the expressions, technical terms, words, content, phrases, sub-headings or sentences to which they had objections, or for which they had suggested improvements. This meant that five successive versions of the survey were produced until consensus had been reached on its wording by most of the thirty volunteer critics.

The first section of the questionnaire comprised biographical data gathering. The second section of the questionnaire required the respondents to state whether they chose to 'agree' or 'disagree' with each of the twenty recommendations offered for improving the teaching and learning of school science/technology curriculum programmes. They indicated their choice by circling 'A' (*Agree*) or 'D' (*Disagree*) for each presented statement.

The last two sections of the questionnaire requested the respondents to focus on, and to select the 'two best' and 'two least important' recommendations out of the twenty for improving school science/technology in Lesotho. The last section was open ended. It required the respondents to give reasons for their two choices of 'best' and 'least' important recommendations, and it asked respondents for further suggestions that might be included for the improvement of teaching and learning of science and technology in Lesotho high schools.

3.2 The survey research method.

Survey sampling is the research method used in this study. It was found to be the most appropriate method in this study since it can elicit information that covers a long period of time from a respondent within a very short time. Surveys are used as they give comparable information for a number of respondents, and can even go beyond descriptions to looking for patterns in data (Burns, 1997:469).

The 20 item questionnaire (Appendix 3b) was used for collection of data. As an investigative technique, the questionnaire has become one of the most used in educational research (Anderson, 1993: 207) since it is regarded as permitting the collection of reliable and reasonably valid data relatively simply, cheaply and within a short space of time. The questionnaires were distributed personally by the researcher herself in Lesotho schools, with the assistance of her sister, brother and sisters-in-law.

Cluster sampling was used in this study because, although it is not necessarily mathematically complete, nevertheless, it is an administratively convenient research strategy for a limited study. The opportunistic sampling method was used in this study and convenient schools were chosen, specifically those willing to help. The different procedures used in administering the questionnaires are discussed under section 3.5.

3.3 Discussion and critique of the research method

It is common for surveys to be undertaken within a research design utilizing comparison groups. However, some discrepancies were encountered among the samples. About 30% of Lesotho primary science teachers, 20% of Lesotho high school teachers and 45% of Lesotho senior high school students did not complete the open-ended section which required them to select and give reasons for their choices of best/least policy recommendations. The absence of a research culture may account for this occurence. On the other hand, a very low percentage of omitted or spoiled responses occurred.

In most schools, some students had to take questionnaires home if they could not finish them within the stipulated time. Hence, there is a possibility that some students might have not completed the questionnaires on their own. The administrative delay in the classroom might have been caused by the mode of instruction.

Finally, possibly the items might also have been translated into Sesotho. Also, this study has limitations, especially in terms of sampling only ten groups of students and teachers from the various districts of Lesotho. Hence the results need to be interpreted with caution.

3.4 The samples and their contexts

Sample 1 consisted of 94 town/semi-rural high school science teachers in Lesotho. About 98% speak Sesotho as their first language. The distribution of males and females was that there were appreciably more females than males, within an age range from 23-60 years.

The questionnaires were administered through various districts of Lesotho. About 30% of the questionnaires were completed by student teachers at the National University of Lesotho (NUL) and at the National Teachers' Training College (NTTC), with two or more years of teaching experience.

Sample 2 consisted of 77 Lesotho primary science teachers. About 100% speak Sesotho as their first language. The distribution of males and females was that there were more females than males, within an age range from 22-60 years. About 30% of the questionnaires were completed by student teachers with two or more years of teaching experience who were from various districts of Lesotho.

Sample 3 consisted of 368 senior high school science pupils in Lesotho. They speak Sesotho as their first language and generally come from both rural and urban areas. Their ages range from 18-25 years. The area surveyed consisted of nine schools, and about 50 pupils in the senior classes were selected per school for the completion of the questionnaires. The ten schools were selected from four districts, viz.: Maseru, Leribe, Mafeteng and Mohales'hoek – marked with stars as depicted in figure 3.1 on page 54.

Figure 3.1 Map depicting the geographical settings of the samples

Map of Africa

3.5 Procedures for data collection

3.5.1 Sample 1 (Lesotho high school science teachers)

Data were collected during the period of April-May-June 1999. The questionnaires were administered during the normal science teachers' meetings held at the resource centres in the various districts of Lesotho. The use of the resource centres was limited so the researcher also moved from school to school, giving smaller groups of science teachers the questionnaires to complete during their spare time. Then the questionnaires were collected after three to four days. Permission was sought from the principals.

About 10% of the questionnaires were completed by the student teachers at the National Teachers' Training College (NTTC) through the help of the researcher's sisters' colleagues. The questionnaires were given to them by the researcher to administer during the first few minutes of their class lectures. Then the questionnaires were collected after three to four days. I gave my sister 20% of the questionnaires to give to the student teachers at the National University of Lesotho, she being a lecturer there. The questionnaires were returned after a couple of days.

3.5.2 Sample 2 (Lesotho primary science teachers)

The questionnaires were administered during the normal school days in April-May-June 1999. Permission was first sought from principals personally by the researcher (myself). Then I was referred to the heads of classes. I left the questionnaires with them to give to the primary teachers. The questionnaires were collected after a couple of days. I in turn went to the National Teachers' Training College (NTTC) to give the questionnaires to the student teachers during their normal lectures. Permission was sought from the teachers concerned. Then the questionnaires were collected immediately after completion. I gave some of the questionnaires to my sisters-in-law to give to other primary teachers in the primary schools in which they were teaching. Then the completed questionnaires were brought back to me after a couple of days.

3.5.3 Sample 3 (Lesotho senior high school students)

The questionnaires were administered during the normal course of science lessons during April-May-June 1999 in Lesotho. Permission was sought from principals personally by the researcher. The questionnaires were given to the heads of science department to give to the science teachers to give to students during their normal science lessons. Some of the students took the questionnaires home and returned them the following day but most of these would claim to have forgotten them at home. About five hundred questionnaires were issued to students to complete, but only three hundred and sixty eight questionnaires were returned.

3.6 Interviews

A research interview is defined as "a two person conversation initiated by the interviewer for the specific purpose of obtaining research-relevant information, and focused by him on content specified by research objectives of systematic description, prediction, or explanation." (Cohen & Manion, 1989:307). In this sense it differs from questionnaires, in that it creates opportunities for probing, in contrast to the questionnaires which deny one access to probe.

As a result, using her analysis as a basis, the researcher constructed follow-up interview guides. They were structured around the purpose of the study and were designed to seek additional insights into the qualitative data obtained from the questionnaires. A sample of five senior high school science students and their teachers were interviewed. Individual interviews were conducted for periods of up to one hour during July 2000, as a follow-up to the questionnaires which were administered in April-June, 1999.

Senior high school form E science students were interviewed in their own language, Sesotho. Their ages ranged from 18 – 23 years. They were studying physics/chemistry and biology, and their performance was on average. They were from semi-rural areas. Three male and two female teachers were interviewed. Their ages ranged from 25 – 50 years and they had 2 – 15 years of teaching experience. One of the male teachers was an expatriate and had been in the teaching profession in Lesotho for more than seven years. Their teaching subjects were chemistry, junior science, physics, biology and mathematics. The high school science teachers were contacted by telephone, a day in advance. A tape-recorder was used in the interviews.

3.7 Data capture and analysis

Quantitative data

A frequency count of the responses to the 20-item data-capturing instrument was first employed, and data were stored in Microsoft Excel 5 software programme in the form of tables (i.e. an *agree* or *disagree* response table; and a *best* and *least important recommendations* table).

Qualitative data

The qualitative data were also captured using Microsoft Excel 5 software. Statements with the same meaning were coded and grouped together, and a frequency count was also undertaken. Suggestions and explanations where fewer than five people supported a certain recommendation, and also where fewer than five people opposed the same recommendation, were not reported on in detail. Finally, in-depth interviews were conducted with selected Lesotho high school science teachers and Lesotho senior high school science students for additional insights into the qualitative interpretation of the data patterns which emerged.

3.8 Selection of statistical methods

A chi-square test for two independent groups was used to test the six null hypotheses. This test is defined as a simple non-parametric test of significance applicable for nominal data where observations can be classified into discrete categories and treated as frequencies (Burns, 1997:183). This was contained in a Statgraphics computer package. In tables where the frequency in a cell was less than five, Fisher's z exact probability test was used.

Chi-square (χ^2) test for a two by two arrangement

In testing the null hypotheses 1a, 1b, 2a, 2b, 3a and 3b, a Statgraphics package for calculating contingency tables in a two-by-two arrangement was used (Sokopo, 1998:46). The chi-square test is sensitive to differences but does not give direction of difference, and is two-tailed (Burns, 1997:194). Minium (1970) describes it as nondirectional.

The general formula used for calculating chi-square (χ^2) is:-

$$\chi^2 = \frac{N(ad-bc)^2}{(a+b)\ (a+c)\ (b+d)\ (c+d)} \qquad \text{with df} \geq 2$$

Where a, b, c and d are the four observed frequencies.

N= a+b+c+d is the sample size .

The following chi-square values are critical: 3.84 (5% level) and 6.64 (1% level) (Burns, 1997:187). The Statgraphics programme also calculates the chi-square value with Yates' correction to reduce possible statistical discrepancies (Minium, 1970:397). This correction applies only to 2 × 2 contingency tables which have only one degree of freedom.

The Yates' formula which incorporates the feature mentioned above is:

$$\chi^2 = \frac{[\, N(\,|ad\text{-}bc| - (N/2)\,)^2 \,]}{(a+b)\ (c+d)\ (a+c)\ (b+d)} \qquad \text{with 1 df}$$

where N/2 is the Yates' correction.

Correlations

Correlation is defined as the mutual relation of two or more things. In this investigation, correlation coefficients were calculated for the agreement responses of samples 1, 2 and 3 in the next chapter. Unlike the chi-square test, a numerical correlation index indicates both the direction and the strength of a relationship between two variables (Burns, 1997: 98).

3.9 Chapter summary

This chapter has presented and described the survey research method, a history of the formulation, compilation, development, reliability and validation of the final instrument from 1995 to 1999 was also outlined, the discusion and critique of the instrument have been made, the samples, a description of how the interview was conducted, the procedures for data collection, the data capture and methods of analysis, and the proposed selection of statistical methods used. The results and findings of the research study now follow in **chapter 4.**

CHAPTER 4

RESULTS AND FINDINGS

The results of the surveys of the three samples, and a summary of findings for the six hypotheses, are presented in this chapter. A comprehensive discussion of the findings occurs later, in a subsequent chapter, following the presentation of the overall patterns of results in this chapter.

4.1 The empirical findings: overall trends

4.1.1 Lesotho high school science teachers (n=94) (sample 1)

The results summarising the response frequencies of agreement/disagreement by the 94 Lesotho high school science teachers in 1999 are presented in table 4.1 on page 63. The recommendations gaining the highest degree of consensus for Lesotho science curriculum policy, design and reconstruction for the year 2000 were found to be:-

Introducing more real life skills in science (item 1);

Encouraging more competitions in science (item 7);

Promoting careers and job prospects in science among school pupils in Lesotho (item 13);

Sharing and increasing the intellectual excitement and sense of adventure which science offers (item 14);

Conducting science campaigns (item 16);

Having more extramural activities (item 17); and

Having better teaching methods (item 19);

The most frequently rejected policy suggestions for the year 2000 were found to be:-

Paying more attention to gender issues in science (item 2); and

Paying more attention to language issues in science (item 5).

Table 4.1 also presents the major policy issues selected by the Lesotho high school science teachers as the *most important recommendation* and the *least important* of the twenty presented for their consideration.

The *most important* curriculum recommendations were again found to be:-

Acquiring more resources (item 15) - 32 votes; and

Having better teaching methods (item 19) - 22 votes.

The *least important* science curriculum policy issues, according to the views and preferences of the 94 Lesotho high school science teachers, for the year 2000 were found to be:-

Paying more attention to gender issues in science (item 2) -37 votes;

Paying more attention to language issues in science (item 5) - 25 votes; and

Science as an entry requirement (item 20) -20 votes.

Table 4.1: The frequency scores and priorities of the 20 science curriculum policy issues recorded by the Lesotho high school science teachers (N=94) in 1999.

Suggestions for improvement	**Response frequencies**			
	Agree	**Disagree**	**Best Recommendation**	**Least Recommendation**
1. More real life skills in science	92	02	**18**	00
2. More gender issues in science	40	51	01	**37**
3. More environmental issues	82	12	09	08
4. Science for community development	69	25	03	16
5. More attention to language issues	43	49	08	**25**
6. More focus on the disadvantaged	79	13	05	11
7. More competitions in science	92	01	10	03
8. More self-discovery in science	89	04	**16**	03
9. Core plus options in curriculum	73	19	04	08
10. More primary school science	84	09	**15**	06
11. Wider community consultations	79	12	02	05
12. Computer-aided instruction	73	20	07	13
13. Promoting careers in science	91	03	05	02
14. Excitement and adventure	90	03	03	03
15. Acquiring more resources	89	03	**32**	04
16. Conducting science campaigns	91	01	04	03
17. More extramural science activities	93	01	10	03
18. External support and recognition	81	09	03	09
19. Better teaching methods	92	02	**22**	02
20. Science as an entry requirement	59	32	03	**20**

4.1.2 The Lesotho primary science teachers (N=77) (Sample 2).

Table 4.2 on page 66 presents a summary of the results from the frequencies of the twenty science curriculum policy recommendations by the Lesotho primary science teachers (N=77) in 1999. The policy recommendations gaining the highest degree of consensus for Lesotho science curriculum policy design and reconstruction for the year 2000 were found to be:-

Introducing more real life skills into science (item 1);

Encouraging more competitions in science (item 7);

Making more use of self-discovery and self-teaching in science (item 8);

Acquiring more resources (item 15);

Conducting science campaigns (item 16);

Having more extramural science activities (item 17);

Having external support and recognition for science students (item 18); and

Having better teaching (item 19).

The most frequency rejected science curriculum policy suggestions were found to be:-

Paying more attention to gender issues in science (item 1);

Paying more attention to language issues in science (item 5);

Changing the science curriculum to a compulsory core syllabus plus many options (item 9); and

Science as an entry requirement (item 20).

Table 4.2 also presents the major policy recommendations selected by the Lesotho primary science teachers as the *most important/least important* of the fifteen science policy recommendations presented for their consideration.

The recommendations favoured as the *most important* were found to be :-

Acquiring more resources (item 15) - 27 votes; and

Having better teaching methods (item 19) - 12 votes.

The *least important* recommendations identified among the 20 were:-

Paying more attention to gender issues in science (item 2) - 17 votes;

Paying more attention to language issues (item 5) -16 votes; and

All interested groups in the Lesotho communities should be consulted (item 11) - 13 votes.

Table 4.2: The frequency scores and priorities of the 20 science curriculum policy issues recorded by the Lesotho primary science teachers (N=77) in 1999.

Suggestions for improvement	**Response frequencies**			
	Agree	**Disagree**	**Best Recommendation**	**Least Recommendation**
1. More real life skills in science	74	02	10	03
2. More gender issues in science	46	30	02	**17**
3. More environmental issues	68	09	09	05
4. Science for community development	61	14	05	11
5. More attention to language issues	40	37	02	**16**
6. More focus on the disadvantaged	67	09	02	08
7. More competitions in science	74	02	09	08
8. More self-discovery in science	72	04	10	01
9. Core plus options in curriculum	55	20	04	04
10. More primary school science	66	09	08	07
11. Wider community consultations	68	06	03	**13**
12. Computer-aided instruction	66	09	05	05
13. Promoting careers in science	65	10	03	03
14. Excitement and adventure	69	05	02	02
15. Acquiring more resources	77	00	**27**	04
16. Conducting science campaigns	76	01	08	01
17. More extramural science activities	76	01	08	04
18. External support and recognition	74	03	05	03
19. Better teaching methods	76	01	**12**	06
20. Science as an entry requirement	46	29	04	11

4.1.3 Lesotho high school science students (N=368) (sample 3).

The results of the frequencies of responses to the twenty science curriculum policy recommendations by the Lesotho high school science students (N=368) (sample 3) are presented in table 4.3 on page 69.

From the individual total frequencies for the twenty items, the suggestions receiving the highest consensus for science curriculum design and reconstruction were found to be:-

Encouraging more competitions in science (item 7); and

Acquiring more resources (item 15).

The most rejected science policy recommendations were found to be:-

Paying more attention to gender issues in science (item 2);

Using science to advance and develop the Lesotho community socially and economically (item 4);

Paying more attention to language issues (item 5);

Changing the science curriculum to a compulsory syllabus core plus many options (item 9); and

Science as an entry requirement (item 20).

Table 4.3 also presents the frequencies of the responses of the *most important/least important* science curriculum suggestions chosen from the twenty recommendations presented to the 368 Lesotho high school science students.

The *most favoured* recommendations for the year 2000 were found to be:-

Acquiring more resources for schools in Lesotho (item 15); -127 votes;

Encouraging more competitions in science (item 7) - 78 votes;

Conducting science campaigns (item 16); - 63 votes

Making more use of self-discovery and self-teaching in science (item 8); - 59 votes

Having better teaching methods (item 19) - 58 votes.

The *least important* recommendations for the year 2000 were seen to be:-

Paying more attention to language issues in science (item 5) - 93 votes;

Changing the science curriculum to a compulsory syllabus core plus many options (item 9) - 49 votes;

Paying more attention to gender issues in science (item 2) - 45 votes; and

Prescribing science as an entry requirement for encouraging future prospects (item 20) - 44 votes.

Table 4.3: The frequency scores and priorities of the 20 science curriculum policy issues recorded by the Lesotho high school science students (N=368) in 1999.

Suggestions for improvement	**Response frequencies**			
	Agree	**Disagree**	**Best Recommendation**	**Least Important**
1. More real life skills in science	305	63	15	17
2. More gender issues in science	244	118	04	**45**
3. More environmental issues	301	62	19	34
4. Science for community development	212	148	11	32
5. More attention to language issues	149	216	08	**93**
6. More focus on the disadvantaged	269	90	04	15
7. More competitions in science	354	16	**78**	22
8. More self-discovery in science	293	65	**59**	19
9. Core plus options in curriculum	205	147	18	**49**
10. More primary school science	304	54	57	**50**
11. Wider community consultations	314	45	03	26
12. Computer-aided instruction	285	72	44	36
13. Promoting careers in science	305	44	26	21
14. Excitement and adventure	288	62	09	16
15. Acquiring more resources	350	12	**127**	16
16. Conducting science campaigns	366	26	**63**	32
17. More extramural science activities	325	34	36	15
18. External support and recognition	303	54	14	15
19. Better teaching methods	336	25	**58**	26
20. Science as an entry requirement	218	135	05	**44**

The overall conclusion drawn from these three tables of findings is that, by consensus of a total of 539 respondents, the most frequently accepted recommendations for science curriculum design policy and reconstruction for school science in Lesotho in the year 2000 were:-

Introducing more real life skills into science (samples 1, 2 & 3)

Encouraging more competitions in science (samples 1, 2 & 3)

Acquiring more resources (samples 1, 2 & 3)

Conducting science campaigns (samples 1, 2 & 3)

Having better teaching methods (samples 1, 2 & 3).

The three recommendations selected as the *most important* among the twenty by all three of the samples were:-

Acquiring more resources (samples 1, 2 & 3) - 186 votes;

Encouraging more competitions in science (samples1, 2 & 3) - 97 votes;

and *Having better teaching methods (samples 1, 2 & 3)* -92 votes.

The three recommendations rated as *least important* among the twenty by all three samples were:-

Paying more attention to gender issues in science (samples 1, 2 & 3) - 99 votes;

Paying more attention to language issues in science(samples 1, 2 & 3) -134 votes; and

Science as an entry requirement (samples 1, 2 & 3) - 75 votes.

4.2 Null hypotheses testing

In this section, the response frequencies of samples 1, 2 and 3 are compared in pairs for each of the twenty science curriculum policy recommendations.

4.2.1 Lesotho high school science teachers (N= 94) (sample 1) versus Lesotho primary school science teachers (N=77) (sample 2).

Ho1 a. There is no significant difference between the responses of the 94 Lesotho high school science teachers (sample 1) and the 77 Lesotho primary school science teachers (sample 2) in the frequencies of their agreement / disagreement with each one of the 20 proposed science policy recommendations.

The chi-square or Fisher's z values recorded in table 4.4 on page 73 for each of the 20 science policy recommendations indicate that the null hypothesis is tenable for items 1, 3-12, and 14-20; but is rejected for items 2 and 13 at the 95% level of confidence ($p<0.05$).

Ho1 b. There is no significant difference between the responses of the 94 Lesotho high school science teachers (sample 1) and the 77 Lesotho primary school science teachers (sample 2) in their frequencies of best / least important priority for each one of the 20 proposed science policy recommendations.

The chi-square or Fisher's z values recorded in table 4.5 on page 74 for each of the 20 science policy recommendations indicate that for all 20 items, the null hypothesis is tenable. Thus the Lesotho primary and high school science teachers are in agreement with respect to the relative importance of the 20 items, overall.

Table 4. 4 A frequency comparison of the agree/disagree responses to the 20 science policy curriculum recommendations of the Lesotho high school science teachers (N=94) (sample 1) and the Lesotho primary school science teachers (N=77) (sample 2)

Suggestions for improvement	Response frequencies: Lesotho primary school science teachers (N= 77)		Lesotho primary school science teachers (N= 94)			
	Agree	Disagree	Agree	Disagree	Chi-square or Fisher's z	P-value
1. More real life skills in science	74	02	92	02	0.09	0.7693
2. More gender issues in science	46	30	40	51	3.91	0.0479 *
3. More environmental issues	68	09	82	12	0.00	0.9836
4. Science for community development	61	14	69	25	1.06	0.3022
5. More attention to language issues	40	37	43	49	0.27	0.6030
6. More focus on the disadvantaged	67	09	79	13	0.04	0.8353
7. More competitions in science	74	02	92	01	0.03	0.8598
8. More self-discovery in science	72	04	89	04	0.01	0.9433
9. Core plus options in curriculum	55	20	73	19	0.53	0.4654
10. More primary school science	66	09	84	09	0.05	0.8158
11. Wider community consultations	68	06	79	12	0.62	0.4297
12. Computer-aided instruction	66	09	73	20	2.00	0.1570
13. Promoting careers in science	65	10	91	03	4.70	0.0302 *
14. Excitement and adventure	69	05	90	03	0.49	0.4860
15. Acquiring more resources	77	00	89	03	1.03	0.3106
16. Conducting science campaigns	76	01	91	01	0.35	0.5570
17. More extramural science activities	76	01	93	01	0.33	0.5669
18. External support and recognition	74	03	81	09	1.49	0.2217
19. Better teaching methods	76	01	92	02	0.03	0.8614
20. Science as an entry requirement	46	29	59	32	0.09	0.7611

* $p < 0.05$ significant difference between samples 1& 2

Table 4.5 A comparison of the best/least important responses to the 20 science policy curriculum recommendations by the Lesotho high school science teachers (N=94) (sample 1) and the Lesotho primary science teachers (N= 77) (sample 2)

Suggestions for improvement	Response frequencies: Lesotho primary school science teachers (N= 77)		Lesotho primary school science teachers (N= 94)			
	Best Choice	Least Choice	Best Choice	Least choice	Chi-square or Fisher's z	P-value
1. More real life skills in science	10	03	18	00	2.34	0.1263
2. More gender issues in science	02	17	01	37	0.40	0.5293
3. More environmental issues	09	05	09	08	0.07	0.7861
4. Science for community development	05	11	03	16	0.46	0.4958
5. More attention to language issues	02	16	08	25	0.58	0.4474
6. More focus on the disadvantaged	02	08	05	11	0.03	0.8613
7. More competitions in science	09	08	10	03	0.94	0.3328
8. More self-discovery in science	10	01	16	03	0.00	0.9704
9. Core plus options in curriculum	04	04	04	08	0.08	0.7799
10. More primary school science	08	07	15	06	0.58	0.4458
11. Wider community consultations	03	13	02	05	0.00	0.9809
12. Computer-aided instruction	05	05	07	13	0.16	0.6926
13. Promoting careers in science	03	03	05	02	0.05	0.8259
14. Excitement and adventure	02	02	03	03	0.42	0.5186
15. Acquiring more resources	27	04	32	04	0.02	0.8790
16. Conducting science campaigns	08	01	04	03	0.76	0.3827
17. More extramural science activities	08	04	10	03	0.02	0.9007
18. External support and recognition	05	03	03	09	1.47	0.2258
19. Better teaching methods	12	06	22	02	2.71	0.1000
20. Science as an entry requirement	04	11	03	20	0.40	0.5282

4.2.2 Lesotho high school science teachers (N=94) (sample 1) versus Lesotho senior high school science students (N=368) (sample 3).

Ho2 a. There is no significant difference between the responses of the 94 Lesotho high school science teachers (sample 1) and the 368 Lesotho science students (sample 3) in the frequencies of agreement/disagreement for each one of the 20 proposed science policy recommendations.

The chi-square and Fisher's z values recorded in table 4.6 on page 77 for each of the 20 science policy recommendations indicate that the null hypothesis is tenable for items 1, 3, 5, 7, 8, 10, 11, 12, 15 and 18-20, but is rejected for items 4, 6, 13, 16 and 17 at the 95% level of confidence ($p<0.05$), and rejected for items 2, 9 and 14 at the 99% level of confidence ($p<0.01$).

Ho2 b. There is no significant difference between the responses of the 94 Lesotho high school science teachers (sample 1) and the 368 Lesotho senior high school students (sample 3) in the frequency of best /least important choice for each one of the 20 proposed science policy recommendations

The chi-square and Fisher's z values recorded in table 4.7 on page 78 for each of the 20 proposed science policy recommendations indicate that the null hypothesis is tenable for items 2, 3, 4, 6-18 and 20, but is rejected for item 1 at the 99% level of confidence ($p<0.01$), and is rejected for items 5 and 19 at the 95% level of confidence level.

Table 4.6 A comparison of the agree/disagree responses to the 20 science policy curriculum recommendations by the Lesotho high school science teachers (N=94) (sample 1) and the Lesotho high school science pupils (N=368) (sample 3)

Response frequencies						
Suggestions for improvement	Lesotho primary school science students (N= 368)		Lesotho primary school science teachers (N= 94)			
	Agree	Disagree	Agree	Disagree	Chi-square or Fisher's z	P-value
1. More real life skills in science	305	63	92	02	0.12	0.7250
2. More gender issues in science	244	118	40	51	16.11	0.0001 **
3. More environmental issues	301	62	82	12	0.73	0.3927
4. Science for community development	212	148	69	25	6.06	0.0139 *
5. More attention to language issues	149	216	43	49	0.83	0.3631
6. More focus on the disadvantaged	269	90	79	13	4.37	0.0366 *
7. More competitions in science	354	16	92	01	1.39	0.2376
8. More self-discovery in science	293	65	89	04	9.89	0.2376
9. Core plus options in curriculum	205	147	73	19	13.00	0.0003 **
10. More primary school science	304	54	84	09	1.37	0.2412
11. Wider community consultations	314	45	79	12	0.00	0.9925
12. Computer-aided instruction	285	72	73	20	0.02	0.8883
13. Promoting careers in science	305	44	91	03	5.97	0.0146 *
14. Excitement and adventure	288	62	90	03	11.19	0.0008 **
15. Acquiring more resources	350	12	89	03	0.09	0.7636
16. Conducting science campaigns	366	26	91	01	3.84	0.0499 *
17. More extramural science activities	325	34	93	01	6.51	0.0107 *
18. External support and recognition	303	54	81	09	1.17	0.2804
19. Better teaching methods	336	25	92	02	2.28	0.1314
20. Science as an entry requirement	218	135	59	32	0.18	0.6750

** $p<0.01$ - shows highly significant difference between samples 1 & 3 for a certain item.

* $p<0.05$ - shows significant difference between samples 2 & 3 for a certain item

Table 4.7 A comparison of the best/least important responses to the 20 science policy curriculum recommendations by the Lesotho high school science students (N=368) (sample 3) and the Lesotho high school science teachers (N= 94) (sample 1)

Response frequencies						
Suggestions for improvement	Lesotho primary school Science students (N= 368)		Lesotho high school science teachers (N= 94)			
	Best Choice	Least Choice	Best Choice	Least choice	Chi-square or Fisher's z	P-value
1. More real life skills in science	15	17	18	00	12.22	0.0005 **
2. More gender issues in science	04	45	01	37	0.40	0.5253
3. More environmental issues	19	34	09	08	0.94	0.3334
4. Science for community development	11	32	03	16	0.27	0.6026
5. More attention to language issues	08	93	08	25	4.85	0.0277 *
6. More focus on the disadvantaged	04	15	05	11	0.09	0.7646
7. More competitions in science	78	22	10	03	0.07	0.7894
8. More self-discovery in science	59	19	16	03	0.24	0.6210
9. Core plus options in curriculum	18	49	04	08	0.01	0.9119
10. More primary school science	57	50	15	06	1.67	0.1960
11. Wider community consultations	03	26	02	05	0.41	0.5204
12. Computer-aided instruction	44	36	07	13	1.82	0.1769
13. Promoting careers in science	26	21	05	02	0.16	0.6932
14. Excitement and adventure	09	16	03	03	0.03	0.8685
15. Acquiring more resources	127	16	32	04	0.08	0.7774
16. Conducting science campaigns	63	32	04	03	0.01	0.9355
17. More extramural science activities	36	15	10	03	0.01	0.9140
18. External support and recognition	14	15	03	09	1.06	0.3039
19. Better teaching methods	58	26	22	02	3.86	0.0493 *
20. Science as an entry requirement	05	44	03	20	0.00	0.9644

** $p<0.01$- shows a highly significant difference between samples 1 & 3 for a certain item.

* $p<0.05$- shows a significant difference between samples 1 & 3 for a certain item.

4.2.3 Lesotho primary school science teachers (N=77) (sample 2) versus Lesotho senior high school science pupils (N=368) (sample 3).

Ho3 a. There is no significant difference between the responses of the 77 Lesotho primary school science teachers (sample 2) and the 368 Lesotho science pupils (sample 3) in their frequencies of agreement/ disagreement for each one of the 20 proposed science policy recommendations.

The chi-square and Fisher's z values recorded in table 4.8 on page 80 for each of the 20 proposed science curriculum policy recommendations indicate that the null hypothesis is tenable for items 2, 3, 5, 7, 10, 11, 12, 13, 15, 16, 19 and 20, but is rejected for items 1, 4 and 8 at the 99% level of confidence ($p<0.01$) and is rejected for items 6, 9, 14, 17 and 18 at the 95% level of confidence ($p<0.05$).

Ho3 b. There is no significant difference between the responses of the 77 Lesotho primary school science teachers (sample 2) and the 368 Lesotho senior high school pupils in their frequencies of best choice or their least important priority for each one of the 20 proposed policy recommendations.

The chi-square and Fisher's z values in table 4.9 on page 81 for each of the 20 policy science curriculum recommendations indicate that the null hypothesis is tenable for all of items 1 to 20.

Table 4.8 A comparison of the agree/disagree responses to the 20 science policy curriculum recommendations by the Lesotho primary school science teachers (N=77) (sample 2) and the Lesotho high school science teachers (N=368) (sample 3)

Suggestions for improvement	Lesotho primary school science students (N= 368)		Lesotho primary school science teachers (N= 77)			
	Agree	Disagree	Agree	Disagree	Chi-Square or Fisher's z	p-value
1. More real life skills in science	305	63	74	02	9.45	0.0021 **
2. More gender issues in science	244	118	46	30	1.04	0.3082
3. More environmental issues	301	62	68	09	1.00	0.3185
4. Science for community development	212	148	61	14	12.43	0.0004 **
5. More attention to language issues	149	216	40	37	2.78	0.0956
6. More focus on the disadvantaged	269	90	67	09	5.51	0.0189 *
7. More competitions in science	354	16	74	02	0.13	0.7166
8. More self-discovery in science	293	65	72	04	6.86	0.0088 **
9. Core plus options in curriculum	205	147	55	20	5.30	0.0213 *
10. More primary school science	304	54	66	09	0.26	0.6110
11. Wider community consultations	314	45	68	06	0.77	0.3802
12. Computer-aided instruction	285	72	66	09	2.20	0.1376
13. Promoting careers in science	305	44	65	10	0.00	0.9842
14. Excitement and adventure	288	62	69	05	4.72	0.0298 *
15. Acquiring more resources	350	12	77	00	1.53	0.2168
16. Conducting science campaigns	366	26	76	01	2.86	0.0910
17. More extramural science activities	325	34	76	01	4.68	0.0305 *
18. External support and recognition	303	54	74	03	6.05	0.0139 *
19. Better teaching methods	336	25	76	01	2.66	0.1028
20. Science as an entry requirement	218	135	46	29	0.00	0.1028

** p< 0.01 - Indicates a highly significant difference between sample 2& 3.
* p< 0.05 - Indicates a significant difference between samples 2 & 3.

Table 4.9 A comparison of the best/least important responses to the 20 science policy curriculum recommendations by the Lesotho high school science students (N=368) (sample 3) and the Lesotho primary school science teachers (N= 77) (sample 2)

Response frequencies						
Suggestions for improvement	Lesotho primary school science students (N= 368)		Lesotho primary school science teachers (N= 77)			
	Best Choice	Least Choice	Best Choice	Least choice	Chi-Square or Fisher's z	p-value
1.More real life skills in science	15	17	10	03	2.27	0.1317
2. More gender issues in science	04	45	02	17	0.03	0.8665
3. More environmental issues	19	34	09	05	2.60	0.1065
4. Science for community development	11	32	05	11	0.01	0.9155
5. More attention to language issues	08	93	02	16	0.00	0.9907
6. More focus on the disadvantaged	04	15	02	08	0.17	0.6776
7. More competitions in science	78	22	09	08	3.56	0.0591 #
8. More self-discovery in science	59	19	10	01	0.56	0.4533
9. Core plus options in curriculum	18	49	04	04	0.90	0.3434
10. More primary school science	57	50	08	07	0.07	0.7858
11. Wider community consultations	03	26	03	13	0.11	0.7369
12. Computer-aided instruction	44	36	05	05	0.00	0.9702
13. Promoting careers in science	26	21	03	03	0.04	0.8501
14. Excitement and adventure	09	16	02	02	0.00	0.9847
15. Acquiring more resources	127	16	27	04	0.00	0.9687
16. Conducting science campaigns	63	32	08	01	1.03	0.3097
17. More extramural science activities	36	15	08	04	0.01	0.9337
18. External support and recognition	14	15	05	03	0.10	0.7542
19. Better teaching methods	58	26	12	06	0.01	0.9344
20. Science as an entry requirement	05	44	04	11	1.39	0.2378

p= 0.06 - Almost significant difference for item 7.

Table 4.10 A percentage comparison of the agree/disagree responses to the 20 science policy curriculum recommendation by the Lesotho science teachers (samples 1 and 2) and the Lesotho science pupils (sample 3)

Suggestions for improvement	Lesotho high school science teachers (N= 94)		Lesotho primary science teachers (N=77)		Lesotho high school science pupils (N=368)	
	Agree (%)	Disagree (%)	Agree (%)	Disagree (%)	Agree (%)	Disagree (%)
1. More real life skills in science	98	02	97	03	83	17
2. More gender issues in science	44	56	61	39	67	33
3. More environmental issues	87	13	88	12	83	17
4. Science for community development	73	27	81	19	59	41
5. More attention to language issues	47	53	52	48	41	59
6. More focus on the disadvantaged	86	14	88	12	75	25
7. More competitions in science	99	01	97	03	96	04
8. More self-discovery in science	96	04	95	05	82	18
9. Core plus options in curriculum	79	21	73	27	58	42
10. More primary school science	90	10	88	12	85	15
11. Wider community consultations	87	13	92	08	87	13
12. Computer-aided instruction	78	22	88	12	80	20
13. Promoting careers in science	97	03	87	13	87	13
14. Excitement and adventure	97	03	93	07	82	18
15. Acquiring more resources	97	03	100	-	97	03
16. Conducting science campaigns	99	01	99	01	93	07
17. More extramural science activities	99	01	99	01	91	09
18. External support and recognition	90	10	96	04	85	15
19. Better teaching methods	98	02	99	01	93	07
20. Science as an entry requirement	65	35	61	39	62	38

$r_{12} = 0.94$
$r_{13} = 0.84$
$r_{23} = 0.90$

Correlations for the agreement responses between samples 1, 2 and 3 are statistically highly significant.

A detailed interpretation of these nine tables of findings, and the results of the six null hypotheses, are discussed in detail in the chapter which follows (i.e. chapter 5). The remainder of this chapter is devoted to a presentation of the major qualitative findings and results.

4.3 Qualitative findings

4.3.1 A summary of reasons given for the choice of best or least important policy recommendations.

This section presents a combined summary of the reasons given for best/least important item choices made by the Lesotho high school science teachers, Lesotho primary science teachers and Lesotho senior high school science students. Samples of the respondents' hand-written reasons and suggestions have been photocopied, and are attached in Appendix 5.

Introducing more real life skills into science (item 1)

The following are the summarised comments commonly given by 43 respondents who were in favour of item 1:-

- If more students are introduced to more real life skills, they can easily see the importance of doing science.
- Students understand science easily if it is related to their everyday life, as science should be taught for life.
- It can encourage students to like science and prosper in the subject.
- Relevance in any form of education is measured by its match to real life situations.

Paying more attention to gender issues (item 2)

The following is a summary of the reasons given by the 99 respondents who were against item 2:-

- Students should not be discriminated according to sex, since any topic can be of interest to a boy or a girl.
- Gender is not so important in the acquisition of science skills, as long as all other methods of imparting information are correctly addressed to equip students with correct concepts in science.

Concentrating more on Lesotho environmental issues (item 3)

The following were the reasons frequently given by the 37 respondents who commented in favour of item 3:-

- There is an urgent need to make people aware of the destruction caused by modern technology on our environment without which we cannot survive.
- Pupils would be made aware of their environment and what they can produce from their environment, hence be inclined to protect the most valuable resources in Lesotho which can aid in the development of the country economically.

The 47 respondents who were against item 3 expressed the views that:-

- If students concentrate on issues affecting only the Lesotho environment , they will encounter problems when they migrate to other countries.
- There should be comparisons with other neighbouring countries.
- There should be no restrictions in science.

Using science to advance and develop the Lesotho community socially and economically (item 4)

The following are the common comments given by the 19 respondents who supported item 4:-

- Pupils will be more interested in the subject if they can experience it being applied in our daily life to solve problems.
- Everything is shifting to politics, etc., so improving and exposing children to these in their early years could be constructive.
- There is a need for a leader who knows the country's environment, i.e. the mineral resources and the physical appearance of the country.

The 59 respondents who were against item 4 raised concerns that:-

- Communities sometimes have negative attitudes towards schools.
- Using science to develop the community is expensive, and is not practicable with the poor state of the country's economy.

Paying more attention to language issues (item 5)

The following reasons were commonly given by the 18 respondents who were in favour of item 5:-

- Use of the primary language or mother-tongue will be of help in that all students will be able to take part in science.

- Language seems to be one major contributory factor to students' low performance in science.
- Scientific English should be introduced, since there are some words which have the same meaning in English as do those which can be used in scientific terms.

However, the 34 respondents who were against item 5 raised concerns that:-

- Most people will have problems when trying to further their studies.
- As long as other methods are mastered, then language is not a problem.
- It is not easy to use the mother-tongue (Sesotho) because of the terminology used in science (i.e. high numbers of misconceptions are experienced with the use of the Sesotho language).

Having the underprivileged majority at its focal point (item 6)

The following are the common reasons given by the eleven respondents who were in favour of item 6:-

- Most Basotho in the rural areas are unfamiliar with details of the latest technology, so this will help them to solve their problems scientifically, not culturally, as is the normal practice.
- It is through science education that we become aware of our environment, its hazards, and how to tackle them.

The 34 respondents who were against item 6 expressed feelings that:-

- Teachers do not have direct contact with the underprivileged.
- Even though we live in the scientific world, it is ambitious to expect that everyone

can be a scientist.

- Science is global, and it has to be treated accordingly.

Encouraging more competitions in science (item 7)

The 97 respondents who were in favour of item 7 expressed the views that:-

- It enables pupils to share ideas with others from different schools and expose them to the situation in different schools and the country as a whole.
- Pupils are made aware that science is very interesting.
- This will boost pupils' morale and interest towards science.
- It promotes the spirit of learning.

The 33 respondents who wrote against item 7 said:-

- This may encourage the spirit of self-centredness or of defeat for those who may not succeed.
- Competitions may discourage those who have not won.
- Competitions can discourage other children who are not good in science.
- When students have gone to the competitions they do not learn to understand, but they go only to win in competitions.

Making more use of self-discovery and self-teaching (item 8)

The following is a summary of the comments made by the 85 respondents who supported item 8:-

- Doing science is all about exploration to develop understanding.
- This will improve pupils' thinking skills.
- Students will be independent in life.
- Child-centeredness is more profitable than teacher-centred learning in education (i.e. all five senses are used).
- It motivates students and gives challenge at the same time.
- Students will have a chance to challenge the universe.
- Students will be able to discover on their own.

The 23 respondents who were against item 8 expressed concern about the time allocation that self activity would not catch up. They also said that if pupils are left to make their own discoveries then those not talented would be left behind.

Changing the science curriculum to a more compulsory core syllabus plus many options (item 9)

The following is a summary of the reasons given by the 26 respondents who were in favour of item 9:

- Students will get a chance to choose science subjects according to their interests and abilities, and this match will make them compatible with the needs of tertiary institutions in Lesotho.

The 61 respondents expressed the feeling that making science a compulsory core will be an infringement of others' interests.

<u>Giving all pupils in Lesotho primary schools much more basic science (item 10)</u>

Many of the 80 respondents gave the following recommendations for being in favour of item 10:-

- If students have a good background of science, they won't have problems in proceeding with science studies.
- A sound basis for the subject at lower levels will provide a better footing for subsequent development of science concepts.

<u>All interested groups in the Lesotho communities should be consulted (item 11)</u>

This is a summary of the reasons given by 8 respondents who were supportive of item 11:-

- If people are given the chance to say their views on how to improve science , they might come up with better and good suggestions.
- The kind of education will be of good quality.

The 44 respondents who were against item 11 emphasised not to concentrate on Lesotho since is surrounded by many other countries, and that most communities in Lesotho consist of semi-illiterate people who do not know much about science.

Using computer-aided instruction and computer interfacing as part of science experiments in Lesotho (item 12)

The following is a summary of the comments given by the 56 respondents who were in favour of item 12:-

- Lately technology is monitored with the use of computers to facilitate efficient communication.
- The kind of education will be of good quality.

54 respondents who opposed item 12 were of the view that computers are expensive, and that they may make students lazy.

Promoting careers and job prospects in science among school pupils in Lesotho (item 13)

34 respondents who were in favour of item 13 raised the following points:-

- Pupils won't hesitate to go for science.
- Pupils will apply more effort.
- Pupils will be eager to learn and have an interest in science.

Sharing and increasing the intellectual excitement and sense of adventure which science offers (item 14)

Although 14 respondents chose this item as a top priority, they did not furnish reasons for their choice .

Acquiring more resources for schools in Lesotho (item 15).

The following were reasons commonly given by the 186 respondents who were strongly in favour of item 15:-

- Pupils learn better if they see things and are actively involved in practical work.
- It is useless to learn complicated concepts by just appreciating them in class and not seeing them in their immediate environment.
- Bringing resources to the students motivates learning and encourages independent learning.
- An adequate supply of equipment enables teachers to impart information better at a higher level.

Conducting science campaigns (item 16).

The following are sample comments commonly given by the 75 respondents who selected item 16:-

- Pupils will see that science is very important in their lives.
- Offering scholarships and bursaries will make students compete and, as a result, they will begin to like science and work hard.

Having more extramural science activities (item 17):-

The following are sample reasons commonly given by the 54 respondents who supported item 17:-

- Excursions give students first hand information.
- Students experience real objects.

<u>Having external support and recognition for science students (item 18).</u>

22 respondents chose item 18, and gave the following reasons for favouring this item above the other items:-

- Putting monetary awards will make students work harder.
- If pupils are encouraged by parents, they will try their best in order to please those parents.

Some of the 22 respondents who did not support item 18 felt that most parents are not aware about the benefits of science, so it would not be easy for them to encourage their children to study science.

<u>Having better teaching methods (item 19):-</u>

Many of the 92 respondents who preferred to focus on item 19 had strong feelings that:-

- This might improve attitudes towards science.
- Better teaching methods will make science interesting.
- Better teaching methods will encourage pupils' participation (more especially a child centred approach.)
- Appropriate teaching methods will equip pupils with skills and make them study.

<u>Science as an entry requirement (item 20).</u>

The following are sample comments given by the 75 respondents who were against item 20:-

- Science is not the only subject to determine an individual's future.

- Other subjects will be undermined if science is made an entry requirement for non-science oriented institutions.
- If a student has a negative attitude towards science, but is then forced to do it, that student might end up leaving school altogether.

Some of the 12 respondents who were in favour of item 20 expressed the view that making science an entry requirement would make students work harder.

Other suggestions offered in the open-ended section of the survey were:-

Learner support

- Science should be made compulsory at O'level.
- Career guidance should be supplied right from primary school level.
- Visits to scientific institutions should be increased.
- Entry requirements to the higher classes or institutions should be revisited, as some requirements hinder students who perform excellently in science from proceeding.
- Science teaching should be integrated so as not to concentrate on the Lesotho environment only, but also to the world as a whole.

Teacher support

- Primary teachers should specialise.
- Teachers' salaries must be rewarding.
- High school science teachers should be taught methodology thoroughly.

- More intensive in-service training should be offered for science teachers.
- There should be regular science workshops, seminars, and part-time studies with which annual contract services are renewable. These should be aimed to equip science teachers with modern approaches and with techniques of teaching science.

Resources

- Companies and all other interested groups in Lesotho should participate in designing science syllabi.
- The examination board and science panel should meet in order to design a different way of assessing science students.
- Curriculum reviews should be carried out regularly.
- The number of universities should be increased.
- Funds: authorities or government should look for additional sources of finance.

4.3.2 Unreported items.

There were no reasons offered for selecting item 14, neither for agreement/ disagreement nor for choice of best/least important recommendations. Also few reasons were offered for rejecting items 1, 2, 10, 13, 15, 16, and 17.

Extracts from the interviews are transcribed verbatim below, in which reasons from the respondents are summarised per question.

4.4 Interview results (for teachers)

SECTION 1: TEACHING PROBLEMS

1. What are your views about the way in which science is taught in Lesotho high schools?

Teacher 1

Learning of science has not reached what is expected. Why? because of laboratories. Science is a practical subject, so if students are just told that will happen, it is not easy for students to understand.

Teacher 2

It is not quite practical, as practical as one would like ... because of lack of equipment ... Also the attitude of some teachers when it comes to experimenting; too lazy to prepare equipment in advance....

Teacher 3

You know, looking at the new syllabus that came out which is still on trial, I think it is ok, basically because it is more child-centred, kind of. Before that, the child will just sit there in class and listen to the teacher and that is it ... We have not been working as a team because we will be sharing ideas.

Teacher 4

The problem is the methods of teaching... In many cases you find that a lot of teachers lack content ... Teachers apply lecture method mostly ... Probably science is not taught so well, but there are some schools in which we could say science teaching is good.

Teacher 5

... Eh! it really depends. It varies with teachers. With some teachers, they do it in such a way that the learner do learn and of this they achieve by letting the learner take an active part... But with others I am sorry to say, a bigger number of them is just the matter of giving, telling the kids the information and as far as I am concerned that is not the way science is taught.... The learner should take part of the whole process ..., the learner should feel it is their thing not the teachers' thing ... I am really not impressed.

2. What do you think could be done to improve the teaching of science?

Teacher 1

The teaching of science could be improved by conducting workshops; establishing students' competitions science as science fairs; providing well equiped science laboratories and well equiped libraries; and teachers should give examples of what students can easily understand or be familiar with.

Teacher 2

Having more equipment could be one of them. Equiping the teaching staff with the teaching methods because you may find that we do have somebody who teaches science but is not a teacher by profession .

Teacher 3

... I think the best thing could really be that one of the teachers working together, not only within the school campus ... We could go to the neighbouring school to do things together ... Also, when we have things like competitions between schools, to give some motivation to the students, even to the teachers.

Teacher 4

Hmm, from my own point of view, is like teachers need in-service training. That is, when they leave universities or teacher training colleges, like in many cases, they still have to acquire ways of dealing with students, i.e. how to teach. Eh, it is like teaching practice or the micro-teaching they do at university level are not adequate.

Teacher 5

Well, what we need to do, is to start with the teacher, ... If we have already failed during our pre-service training, it means in-service training has to take over ... The teacher trainers should look into their teaching programs, so that they emphasise learner involvement ... It should be part and parcel of the pre-service ... In-service training should be a must for science teachers.

3. What can you say about the way science is learned?

Teacher 1

Some schools which have at least well equiped science laboratories are trying to teach science the way it should be taught; that is, more towards student-centred method. But with some schools which lack equipment, it is a pity because a practical subject like science is taught through lecture method which is not effective to teaching of science.

Teacher 2

... I do not know how I can measure the learning ... usually pupils who opt for it (science) usually work hard. There are few of them that just regard it as one of those subjects and, in the final analysis, they fail it in the exam.

Teacher 3

Eh, ... I think looking at science ... because it is all about life. When you talk to them (students), what science is all about, they get excited, they want to know more, in this new system. They go out of their way to discover certain things for themselves.

Teacher 4

... For me, my school is out of question, it is only a few pupils which do read. Hey! you have to push them.

Teacher 5

... They (learners) do not actually answer your question. The learners do not know how to learn because nobody is helping them.

4. Do you think the way it is learned is influenced by teaching methods?

Teacher 1

Yes, teaching methods do influence the way science is learned.

Teacher 2

I think because like I said, is lecturing and demonstration. It may be some of them do like it ... Those who do not like it, if they get to JC, when they fail, they do not even want the teacher who teaches science completely.

Teacher 3

... Yah ... maybe it had something to do with their attitudes towards education in general, not science in particular.

Teacher 4

I think it does to some extent, depending on how your teaching is planned.

Teacher 5

Exactly, the way they (learners) are handled by the teacher. If my teacher says I should learn things by heart, as the teacher, he is giving me a picture of how to learn, learning things by heart. So it goes back to the way he handles the learner.

5. What do you think could be done to improve the situation?

Teacher 1

Teachers should try to vary teaching methods even though this would be made easier by availability of equipment.

Teacher 2

I think if they (pupils) carry out experiments themselves. If they are allowed to handle the equipment, sometimes they discover things that we otherwise not demonstrate to them ... They make some observations that we do not even expect ... I think it might motivate them.

Teacher 3

... When they (learners) come into the system, we should start by grooming them into reading. Maybe we should at least, once a week, for them to study in the library with somebody's supervision. Maybe in that way, starting with the form As, as they grow older, definitely they will have that in their blood, and study, maybe ....

Teacher 4

Eh, sometimes if we structure our teaching in such a manner that it will require them (learners) to read more ... I do not think our textbooks also are interesting enough for the kid to pick up the textbook and read it ... We should involve the kids in extracurricular activities ... For example, things like science fairs, competitions, ... Therefore they have to acquire knowledge ... They have to come up with research projects, and some models where they have to construct things. They have to get some information from textbooks, I think maybe we encourage more of that.

Teacher 5

It is again the responsibility of the teacher to assist the learner to know how to learn. This is the missing bit with teachers. So we have to work as teachers or be assisted somehow to develop a clear picture of how we should teach science, because the learners are ready to do what they are requested and facilitated to do. So it is left with us teachers to do much work.

SECTION 2: ACQUIRING MORE RESOURCES

6. Is there a need to acquire more resources for Lesotho schools?

Teacher 1

Yes, there is a need.

Teacher 2

Yes.

Teacher 3

Eh, it really depends, eh some schools do not have enough, but then, talking for my school, I do not think we have adequate equipment of science.

Teacher 4

I would say, probably they (teachers) need more workshops before we could talk about acquiring more resources ...

Teacher 5

Hey, I have been struggling with that ... Should we request Ministry of Education to put more science laboratories in schools? ... Of course, laboratory is an essential but, if we cannot afford it, in the meanwhile let us work out the means of being successful where we are, ... Because really it will take some time for some schools to have a four roomed house labelled 'science laboratory', but if we have any room and have technical materials then let us do that.

7. Do you think the already existing materials are efficiently used in schools? Explain.

Teacher 1

They are not efficiently used. I think teachers need workshops, since we are using foreign materials. Some of them (materials) we are not used to, and we have never used them during our training, so it is not easy to go and try to introduce them in front of kids.

Teacher2

In some cases no, because of the attitude of the teachers themselves, particularly if they have not been skilled with the teaching methods. In some cases, you find that there is equipment but it is not used, although there are fewer such schools, but I think they are kind of not properly used.

Teacher 3

Yah, the existing materials do help. Very, very few teachers use the materials, ... The teacher not feeling confident and as a result, some feel they (students) are ok, what is the need of using these materials? ... They take students not to be thinking that - if I do not do this - 1, 2, 3 might happen.

Teacher 4

There is no what we call hands-on activities by students who are doing work in the laboratory. We get reports from the inspectorates and the people who are dealing with the science curriculum on their visits to schools ... that laboratories are there and the equipment is there and dusty or the laboratories are used as store rooms for equipment of agriculture or sports equipment, ...

Teacher 5

... There are some schools with good equipment, good laboratories and all that stuff, but, they amount to nothing, ... In yet other cases, you find teachers who are struggling, trying to improvise

8. Do you think if all schools could 'adequately' be supplied with resources, then the teaching and learning of science might improve?

Teacher 1

Once more, if students are using material things, that will create more interest, they (students) will see that science can apply in real life situation.

Teacher 2

Yes, if the teaching staff is provided with skills for proper usage of resources ...

Teacher 3

Well, I think so, but then I think we should not stop there. Teachers need in-service training. It must continue, and workshops, because science is dynamic ... teachers need to be re-equiped, maybe from time to time.

Teacher 4

... Probably, but teachers need more workshops on the usage of resources, ... so that when they are ready, or we see that they are competent, then they can get more resources, or more materials can be acquired.

Teacher 5

I wonder, ... because in some cases they (resources) are not being put into use.

9. Which resources do you think should be given the first priority and why?

Teacher 1

Laboratories. That is the only thing that teachers can easily use to help so many students in a class. Again the materials that are used in most cases are not so expensive. For example if we use computers, computers are very expensive and difficult to learn in the side of students. It will need more time.

Teacher 2

I do not know, maybe I will be biased (laughs). I will base myself on chemistry. Usually the equipment involved is not expensive ... As far as physics is concerned .... I used to understand it better if I saw something, so I feel well-equiped laboratories should be given the first priority.

Teacher 3

Eh, resources. Looking at the world we are in today. It is in technological terms ... It would be very nice if we could be connected to the internet ... I should think schools do have money. Annually maybe buy two computers ... In four years time we will have enough, maybe to run the school.

Teacher 4

... Laboratories, well equiped and ... should we say, resource books or textbooks, where they can get the information.

Teacher 5

... The environment the teachers and students are in, is very rich itself. I do not deny the fact that technical materials are needed and necessary, for any room could be identified as a science room in the meantime when the laboratories are not there.

10. Do you think these resources would be efficiently used in schools?

Teacher 1

They may be used efficiently.

Teacher 2

I believe that, if it is the person who has been taught how to teach science...

Teacher 3

Yes, I should think so.

Teacher 4

As I have already outlined, if we could start by equipping teachers with skills.

Teacher 5

... Assist the teachers to make use of laboratories where they have them, and there are some pieces of equipment which myself could not use.

11. What do you think should be done to equip science teachers with skills for proper usage of the resources?

Teacher 1

I think teachers should be trained, maybe by conducting workshops for them. Equip them with new information time and again.

Teacher 2

They themselves becoming teachers ... But if the resource centres could enable us to do some of these experiments ourselves, to observe even before we can do them with the students, may be that could help because sometimes you find that it may be lack of time that may make the teacher not to be enthusiastic to set up experiments ... Even if time does not allow we will try to push matters, to such extent.

Teacher 3

As I said, there should be a continuous in-service kind of, for training teachers . Hmm, even the school itself. Maybe teachers could group themselves ... If they have problems, maybe they could get supervisors from the resource centres to help.

Teacher 4

... Teachers need more workshops ... and more in-service training.

Teacher 5

... We should work towards finding some people who are knowledgeable about the use of all the equipment to assist us (teachers).

12. Do you think our pupils have the reading culture? If "not", what do you think should be done to help them? If "yes", please justify your answer.

Teacher 1

No, they do not ... Parents do not take responsibility of their kids, they led them go watch television, they send their kids maybe to do some other work other than school work ... Teachers themselves need to motivate students to read, ... or try to bring interesting materials. Stop giving students old materials in the library which will bore students.

Teacher 2

Eh, eh, they do, they have ability to learn something, even if they cannot read it because of lack of books, since they are very expensive. But you find that they have grasped something which can make them pass, which means that they do learn something.

Teacher 3

Yah, yay, that is a big big problem, it is really a problem ... We do not know what is happening at primary schools, so when they come into the secondary schools, English itself is a problem, so the first few months, 1st quarter, 2nd quarter, English is still a problem for most of them, but then after some time they start picking up bit by bit, but I think the whole system should be encouraged to read ... It creates a problem to tell them to go and study, they never had it in them, so when they reach form D, form E, is very very difficult to impose it on them.

Teacher 4

Hmm, I think it depends on, maybe the upbringing at home, part of the school environment and also the village environment, something like that ... Even reading a novel is a hassle. So in other schools, ... boarding schools or schools in the villages, eh, you find that kids somehow become involved more, take up reading as a hobby and even reading textbooks comes easier for them.

Teacher 5

Our pupils do not have the reading culture ... We have to do our teaching in such a way that the learner gets involved and interested ...

SECTION 3: MORE COMPETITIONS IN SCIENCE

13. Do you think competitions in science could be used in promoting the teaching and learning of science? Explain.

Two sides were considered **:-**

Teacher 1

Competitions can promote the teaching and learning of science. Whenever one competes, he will always try to be the best and to be the best means one has to work hard, and that will lead to good results. I see more advantages ... I do not see anything bad about competitions. Nothing is perfect.

Teacher 2

Hmm, I think it could ..., to raise the interest of the child, when one is learning with a view of achieving something, even that glory only of saying I topped so many students in the competition. It makes that student work harder ... and to change attitude towards science.

Teacher 3

Yes, as I have already pointed out.

Teacher 4

Yes, it could. Hmm, in some cases it could be disadvantageous in that, if it is the competition within a class as such, depending on how we approach it as teachers ... If we make them aware that they are competing against themselves, not against other students say, that they are competing in a way that they are improving their own results ... I do not see any disadvantages, competition is good.

Teacher 5

Definitely, definitely, being competitive is one of the attitudes that we really want to develop in our students ... If I were to compete as a learner, I would hate it because I know I really did not want to be exposed (my limitations) myself ... So if there are such characters ..., competition part of it could be a disadvantage to them.

14. Do you think science teachers have 'adequate' skills to prepare students for science competitions?

Teacher 1

Some have, but some do not. Some were exposed to such maybe during their learning days. Some (teachers) is a new thing, so it is not easy to conduct competitions unless they (teachers) are called for workshops.

Teacher 2

Hmm, some (teachers) do, particularly when they have the teaching methods, that is, when they have been taught how to teach children. They (teachers) could. They could, ... if they are equipped with teaching methods. It is only when one is not interested in that, when he does not find a need and the strength to do it but those who are equipped, I think they can.

Teacher 3

Eh, I should think so, if teachers are ready to admit, the teacher saying I am confident and I feel I can do it; or the teacher to say I feel I am not confident enough, then get some help ... If we are able to admit, ... we will be able to push science to the limit.

Teacher 4

Hmm, not really ... If I give science fairs as an example, you will find that many students do not come up with projects themselves ... Probably it (project) has been given to the student to present it, or it is done by a student under a strict instruction of the teacher ... So, in other cases, teachers do not know where to start or how to prepare students for competitions ...

Teacher 5

No, not really, but the little we are doing is being effective to some extent. I think all that has to be done is to arrange some training, to know exactly how to handle competitions.

SECTION 4: HAVING BETTER TEACHING METHODS

14. Which teaching methods do you think are commonly used by Lesotho science teachers?

Teacher 1

Teacher and child method, whereby the teacher and student participate in learning; but students should participate more than the teachers can do ... The teacher should act as the guider, and 95% of the work should be done by the students. It happens in some schools but in some it does not. Students are just taking 25%. The teacher is feeding the information to students.

Teacher 2

Lecturing and demonstration are usually the ones that are done.

Teacher 3

Most teachers are using that old method: the teacher stands there, and talk and talk for forty minutes and sit down in class.

Teacher 4

In most cases teachers use lecturing and demonstration.

Teacher 5

... We cannot deny it, for the past years and even in the higher institutions of learning, (laughs), the method used is the lecture method. So we tend to believe that is the best method.

15. What do you think might be the cause for not using other teaching methods?

Teacher 1

I think some teaching methods are expensive such as field trips. It is not every school in our country that can afford to take students for fieldtrips. In addition, most of our schools have limited equipment, where you may find 25 students sharing equipment.

Teacher 2

Sometimes, because of lack of equipment; sometimes because teachers do not want to assemble the equipment that will be used at least by less than ten students per equipment ... so they tend to lecture, demonstrate and even give notes.

Teacher 3

Most of the teachers, I feel, maybe the training they had in the past was geared towards that.

Teacher 4

Lecture method and demonstration is the easier way out; you do not have to prepare that much, as compared to when you want pupils to work in the laboratory. You prepare worksheets, materials that pupils will use; so, that requires a lot of time. If you have one laboratory, and someone wants to use it before your lesson, is a problem that means more laboratories.

Teacher 5

... It is because of the lengthy syllabus. The standard of English with our kids is so poor that one has to resort to telling them or, at times, some concepts need the lecture method.

16. From your own point of view, do you see a need for Lesotho science teachers to be upgraded in some teaching methods? Explain.

Teacher 1

I think so, because some of the teachers do not apply appropriate methods of teaching science because they are not aware of some things.

Teacher 2

Yah, there is, because of the kind of things I said of teachers, particularly those teachers that do not have teaching at all. Sometimes they think that there is no need of doing some things, it is just a matter of dishing out information to students, whereas in actual fact they should make the students learn.

Teacher 3

I should think so, especially those who came from school many, many years ago. They really need to be re-trained, maybe into this new methods of teaching ... It would be wrong for me to say only them. Eh, we also have teachers who have not done education as a qualification, so for such people as well, we need to keep training them...

Teacher 4

They do need to, as indicated earlier on.

Teacher 5

Definitely, definitely ... But the lecture method - what I want to see happening is improving on it ... because they (teachers) will say, "No way out, we have to use lecture method" ... They (teachers) will give chain of reasons why they have resorted to lecture method.

17. Which teaching methods would you prefer to be mostly used in science lessons, and why?

Teacher 1

It is commonly called student-centred ... I prefer that one because you do, you understand. If you are told, it is very easy to forget. If you do something you will have interest in it. Unlike when you are told by somebody, that will depend on the tone of that somebody who is telling you that. You may easily be bored.

Teacher 2

Discovery method, if equipment allows ... and even if it is not discovery, but if students handle equipment themselves, or compile data. I think when they do it more often, things become more simple in learning.

Teacher 3

I think child-centered method ... Sometimes we use what we call regulated learning where you use groups. You group the students and give a worksheet to them. In that case the teacher becomes the facilitator. The teacher moves from one group to another, helping pupils discover what he wants them to discover on their own.

Teacher 4

Eh, to use pupil-centred, ... in my case I think pupils should be more involved, even in the planning of the activity. For example, ... if we want to ... show that light is necessary for photosynthesis ... I would prefer ... students to come up with (ideas) suggestions as to how to carry out such an experiment, so what the teacher does is just to probe ... Because if they (students) are just to follow instructions, ..., they are not being active, they are doing something practically but they are not using their brains that much.

Teacher 5

I have been advocating learner-centred approach which includes whatever possible activities that will make the learner do something ... At times we have to be cheaters, in that we should make students learn even when they do not intend to. So we should know our students, so that if you know what Nthabiseng loves to do, ... is better to develop what already exists ....

18. What do you normally do, when students do not understand what you are trying to put across in English?

Teacher 1

I try to give them examples of what they know. I will even bring to the class, materials that that could help them to understand. The use of teaching aids is very important there. If the problem is English, we even use Sesotho. Concepts cannot be said in Sesotho, it is very very rare.

Teacher 2

(Laughs) ... I often say it several times; but if I can sense in fewer cases that they are really interested, they keep on asking, ... I try to simpify the language, demonstrate with hands, with equipment ... It is only in fewer occasions when I might turn to Sesotho, but even then, for a concept which I think does not pass well ... It is form As that usually give problems, ... may be is their attitude when they first come into the high school, ... When they (form As) get to form B, form C ... there are fewer problems, ... in form E they are just alright.

Teacher 3

As one prepares for the lesson, you realise that some words are difficult, especially for the lower classes. Then I take the initiative of asking other teachers what those words mean in Sesotho. Then I will be in a position to tell students such kind of words in Sesotho. But mostly I try to simplify my English.

Teacher 4

Hmm, my pupils have no problem of English. But in cases where they (students) cannot understand, even if one has tried to simplify his/her English to primary level, I do not think bringing across an idea in their mother language, or bringing it across again in English, I think that could help.

Teacher 5

I would try to use as simple English as I could manage ... I would try to create a situation that is commonly known to them (pupils), and even sort of dramatise the activity, but still trying to use simple English ... I try to avoid giving it in Sesotho throughout, but I would here and there bring in some Sesotho words ...

4.5 Interview results (for students)

1. Na u rata 'science' ? Ho joalo (ha ho joalo) hobaneng?

(Do you like science as a subject? If so (not) why?)

Student 1

E, kea e rata. Hobane ho latela maemo ana a hona joale tjena, lintho tse ngata li hloka 'li-science' ' le `na ke hloka hoba e 'ngoe ea lintho tseo, mohlala bongaka bo hloka li 'science'.

(Yes, I like science because, nowadays, there are so many things which require one to have done the sciences, for example, being a doctor; and I would like to be one of such people...)

Student 2

Kea e rata, feela e seng haholo, hobane ha ngata e tsamaea le lipalo, joale lipalo lia ntlhola. Hoja e ne e sena lipalo nkabe ke e rata haholo.

(I like science, but not that much, because it requires some mathematics and I am not that good in mathematics. If it did not require mathematics of some sort, I would love it even more.)

Student 3

Ha se thuto eo ke e ratang, ena le lipalo joale lipalo lia ntlhola. Hoja e ne e sena lipalo nkabe ke e rata.

(I do not like it. It involves mathematics and I am not that good in mathematics. If it did not require mathematics of some kind, I would like it.)

Student 4

Ke thuto eo ke e ratang. Hobane e batla e le thatanyana, `me batho ba bangata ha ba e etse. Joale mesebetsi ea eona e batla e fumaneha ha bobebe, haholo ha u se u e pasitse.

(I like it, because it is a bit difficult. Many people do not opt for it. As a result, it is easier for one to get a job, more especially after passing it.)

Student 5

Ke thuto eo ke e ratang haholo. Ha ke sheba lintho tse ngata ho eona, ho na le mekhoa e mengata ea hore u ka e sebelisa ntlheng ea bophelo. Ha e ts'oane le 'li-accounts' hobane tsona mesebetsi ea tsona ea fokola, empa 'li science' tsona li na le lintho tse ngata. Mehlala, 'engineering', bongaka, ho ba moqhobi oa sefofane, menyetla ea mosebetsi e mengata.

(I like it so much, because there are so many job opportunities when one has done the sciences, like being an engineer, a doctor, a pilot, etc.; unlike accounting where there are fewer job opportunities.)

2. 'Science' le e rutoa joang?

(How are you taught science in your school?)

Student 1

Hona tjena re batla re ba ka ntlong ea boithutelo ha ngata, ha ho ts'oane le lemo se fetileng. Ha re ne re ea 'laboratory' hangatanyana.

(We spend most of the time in the classroom, unlike last year when we used to go to the laboratory most of the time.)

Student 2

Ke bona re e rutoa hantle, feela ka lenama le ka botsoa.

(It is taught well; however, in a demotivating manner.)

Student 3

Ache re na le matichere a re rutang eona hantle, re fuoa 'li-notes', hore haeba motho u sa utloisisa hantle nakong eo u neng u hlalosetsoa, bonyane ha u filoe li 'notes' u fihla u bala hae, u utloisise.

(We have teachers, who teach it so well. We take notes, so that if one did not understand whilst in class, one could go and refer to the notes at a later stage.)

Student 4

Re fuoa 'li-notes', re etsa 'li-experiments', 'li-notes' ka nako e `ngoe rea iketsetsa.

(We are given notes, and at times we make notes ourselves, and we do experiments)

Student 5

Boholo ba nako rea hlalosetsoa, re ngolloe 'li-notes'. 'Li-experiments' oa fumana hore hangata re joetsoa feela hore ha o ka etsa 1, 2, 3 u tla bo fihletse ntho e itseng, kapa ha u etsa 1, 2, 3 u tla fumana ntho e itseng.

(Most of the time things are explained to us, and then given notes. This is also the case with practical work, we are just told that if you do 1, 2, 3 and then you should expect 1, 2, 3 as your outcome.)

3. U ka rata ho rutoa 'science' joang?

(How would you like to be taught science?)

Student 1

Nka rata ha re ka ra ea 'laboratory' ha ngata, ... Lintho tseo re li etsang ebe rea li fumana hangata, ... Mohlala oo re u etsetsoang ebe lintho tseo re li bonang, re iketsetse li 'experiments' ele hore (science) e re nolofalle.

(I would like to be taught science through hands-on experience. Explanations given should be what we can verify in class. In that way I think science will be simpler.)

Student 2

Nka utloisisa ha re ka fuoa (science) 'li-test' tse ngata, hobane joale ha re li fuoe, re li fuoa ka Hlakubele le Phuptjane feela. Mohlomong ha re ne re ka li fuoa labohlano le leng le le leng.

(I think I would understand science if we could be given tests more often, because at present we are given tests in March and June only. Maybe if we could be given tests every Friday.)

Student 3

Ka mokhoa oa ho fuoa 'li-notes'. Ka ho hlalosetsoa pele, joale ebe re fuoa 'li-notes'.
(When things are explained to us, and then given notes thereafter.)

Student 4

Ke rata ho fuoa 'li-notes', le hore ha o ntse o hlalosetsoa ntho ebe u ntse u iketsetsa 'li-notes', e batla e thusa-thusa.
(I like being given notes after explanations, but at times it helps to make notes for myself whilst the explanation continues.)

Student 5

Ke bona eka e ka ba betere haholo. Ha boholo ba nako re ka etsa 'li-experiments', hobane ha u e etsa 'practically' le 'theoretically' e khona hore e lule ka kelellong. Hobane ho na le lintho tse ling tse sa khonahaleng ho hlaloseha, ho batlahala hore o hle o ts'oare lintho ka matsoho.
(I think it would be better if we could do it (science) both practically and theoretically. In that way I think it would be retained in one`s memory even longer, because there are some things which are difficult to explain, so having hands-on experience would do.)

4. Ke eng e u thabisang ka ntlong ea boithutelo ea 'science'?

(What interests you in a science lesson?)

Student1

Ha ke le ka 'laboratory' ke hona ha ke khotsofetse haholo, re etsa li 'experiments'

(I become happier when doing experiments in the laboratory.)

Student 2

Ke ha ke bona tichere ea ka e thabile, a sa fetohe, ha atla a koatile, hosane a tla a thabile , ache ha ke rate, ha a thaba a thabe nako ena kaofela, le ha a koata a koate nako ena kaofela, ke tsebe ho mo tloaela a le joalo.

(Science interests me when I am taught by a cheerful teacher. I am irritated by a moody teacher.)

Student 3

Ke ha re etsa 'li-experiments' madam, hobane u oa li bona lintho tseo ho buoang ka tsona, haeba u sa li kholoe. Nako e `ngoe ha u ne u bone ntho bukeng feela, mohlomong ha u e bona ka 'microscope' u tseba ho e bona hore ke ntho e tjena.

(When doing experiments, madam, because at times we see things in books and do not believe in them, but if we see them in a microscope say, whilst in the laboratory, we see what we have been talking about.)

Student 4

Ha re fuoa 'li-notes' ha re qeta ho hlalosetsoa.

(When given notes, after an explanation has been given.)

Student 5

Ha e (science) etsoa 'practically' le 'theoretically'.

(When science is done practically and theoretically.)

5. Le ea 'laboratory' ha kae ka beke, ho ea etsa 'li-practical'?

(How often do you go to the laboratory per week, for practical work?)

Student 1

Ho hang ha re so e 'laboratory' lemong sena.

(We have never been to the laboratory this year.)

Student 2

Kea kholoa ha `ngoe ka khoeli kapa ka nako e `ngoe ho feta tse peli kapa tse tharo.

(Maybe once in a month or in two or three months.)

Student 3

Bo habeli ka beke, feela lemong sena ha re so e 'laboratory' ho hang, esale re qetela ha re etsa 'form D.'

(We have never been involved in any practical work this year. But last year we used to go to the laboratory twice a week.)

Student 4

Rea bo habeli ka beke ho latela hore lintho (equipment) tse ling lia haella, ho e ho hlokahale hore re etse 'experiment' ebe re fumana li (equipment) le sieo ka 'laboratory', chehe ha li ne li kaba teng mohlomong re ne re ka ea hangatanyana.

(Approximately twice a week, because of lack of equipment in the laboratory. Maybe if we could have it (equipment), we could go to the laboratory most often.)

Student 5

(Oa ts'eha). Ha re e, ke ka lehlohonolo re eang 'laboratory'. Mohlomong ha `ngoe ka mor`a khoeli tse tharo, mohlomong, mohlomong.

((Laughs). We do not go to the laboratory, we rarely go there. Maybe once in three months.)

6. Le iketsetsa li 'practical' ka bo lona kapa mosuoe kapa mosuoetsana o le etsetsa tsona.

(Do you carry out the practicals yourselves (students) or does your teacher carry out demonstrations?)

Student 1

Re ne re iketsetsa (experiments), re ne re joetsoa hore na re etse joang.

(We used to carry out experiments ourselves, with the guidance of the teacher.)

Student 2

Rea iketsetsa

(We do experiments ourselves.)

Student 3

Rea li etsetsoa, ha ke hopole ho thoe re iketsetse.

(They (experiments) are done for us; I do not remember doing experiments ourselves.)

Student 4

Rea li etsetsoa, re se re kile ra iketsetsa ka lihlopha feela e seng ha ngata.

(They are demonstrated to us; we are rarely given a chance to perform experiments ourselves.)

Student 5

Re etsetsoa 'li-demonstrations'. Ke ha `ngoe re kileng ra iketsetsa, ke ha re ne re etsa 'light', ... Ka nako e `ngoe ho tla bitsoa a le mong, ebe oa joetsoa hore etsa tjena, etsa tjena, ka pele ho 'class'. Ha ngata rea etsetsoa.

(Demonstrations are done for us. We once did experiments ourselves when dealing with light. At times one of us will be called to the front to demonstrate to us with the guidance of the teacher. Most of the time, demonstrations are done for us.)

7. Le fella hantle ka 'laboratory'?

(Is the laboratory spacious enough to accomodate every member of class for practical work?)

Student 1

Ache, re fella hantle, feela ha re ne re le form D re ne re le bangata, re petetsana, kea kholoa re ne re le 62.

(The laboratory accomodates us only this year. Last year, when we were in form D, we used to be congested because we were about 62.)

Student 2

E, re fella hantle, empa ho oa bata ka 'laboratory'.

(The laboratory is spacious enough, but it is just too cold in there.)

Student 3

E, re fella hantle.

(Yes, it accomodates us comfortably.)

Student 4

E, re fella hantle.

(Yes, it is spacious enough.)

Student 5

E, re fella hantle

(Yes, it accomodates us so well.)

8. Na le lebelletsoe ho etsa raporoto?

(Are you expected to write a lab report?)

Student 1

E, ne re etsa joalo.

(Yes, we used to do so.)

Student 2

E, re lebelletsoe ho etsa joalo.

(Yes, we are expected to write laboratory report.)

Student 3

E, lemong se felileng.

(Yes, last year.)

Student 4

E, ke ntho eo re se kileng ra e etsa, haholo-holo lemong se fetileng.

(Yes, we did write laboratory reports, more especially last year.)

Student 5

Ha ke hopole re etsa joalo.

(I cannot remember doing so.)

9. U ka rata ho rutoa 'science' ka puo efe? hobaneng?

(In what language would like to be taught science? Why?)

Student 1

Ka sekhooa le ka Sesotho ... Ha ho rutoa ka sekhooa feela nako e `ngoe, kaha re bangata, ngoana e mong le emong ha a khone ho utloisisa. Ha ke lumele ka Sesotho feela ho ka ba bobebe, hobane ho na le lintho tse ling tse sa lumelleheng ho hlaloseha ka Sesotho.

(In both Sesotho and English ... Since we are many in class, there are fewer chances for each one of us to understand when taught in English. I do not think it is possible to be taught in Sesotho throughout, because there are some things (scientific terms) which cannot be translated to Sesotho.)

Student 2

Ka sekhooa, hobane sekhooa ke sona se re lumellang ho 'communicate' le batho ba bangata...

(In English, since we can only be able to communicate with many people in English ...)

Student 3

Puo ena ea sekhooa ke eona e loketseng, hobane u tseba hore u ee naheng tse ngata, ke eona 'official language' e buuang. Hore o tle o tsebe ho bua le batho lefats'e ka bophara.

(In English, because we will be able to communicate with many people from other countries, as English is an official language.)

Student 4

Ka sekhooa, hoba se tsejoa ke batho ba bangata lefats`e ka bophara.

(In English, because it is known by many people worldwide.)

Student 5

... Ha ngata nka e thabela ka senyesemane hobane lintho boholo li batla li etsoa ka senyesemane. Joale ke bona e tlabe ele bokoata kapa bona booatla ha re ka sebetsa lintho ka Sesotho, ...taba ea 'communication', ... ke batla ke hatella taba ea 'communication', hoba sekhooa ke sona 'international language'., ke sona se batho ba kopanang ka sona.

(I would be happy if it could be taught in English in many cases, because many things require one to know English. So, I think it would be stupid to be taught in Sesotho ... I would like to put more emphasis on communication, since English is an international language, it is the language that brings people together.)

10. Ho na le nako eo u eng u lakatse ho botsa lipotso ka Sesotho?

(Are there some cases when you feel you could be given an opportunity to ask questions in Sesotho?)

Student 1

E, mohlomong bothata e le sekhooa.

(Yes, especially when one fails to communicate in English.)

Student 2

E, e teng, ha ke sa tsebe ho itlhalosa hantle ka senyesemane.

(Yes, there are times like that, when failing to express myself in English.)

Student 3

E, ka nako e `ngoe bothata e le sekhooa.

(Yes, at times, when one fails to communicate in English.)

Student 4

Ho latela hore ho thoe re bue sekhooa, maikutlo ano ha a ka ba a be teng.

(I never feel like that, because we are advised to speak English all the time.)

Student 5

E, haholo haeba ke sa utloisisa, eba mohlomong mosuoe kapa mosuoetsana ha a itlhalose hantle, ke e ke phasolohe ka Sesotho, `me ke lebeletse hore le ena a nkarabe ka Sesotho e le hore ke tle ke tsebe ho utloisisa hantle, mohlomong le `na ke se nka ka tseba ho fetolela sekhooeng.

(Yes, more especially if I do not understand when the teacher explains, I will just find myself saying something in Sesotho, expecting to be answered in Sesotho in return. Thereafter I will try to translate whatever information given in Sesotho to English on my own.)

11. Ba sebetsang hantle haholo thutong ea 'science', ke banana kapa bashanyana? Lebaka ke lefe?

(Do boys or girls perform better in science? Why is this the case?)

Student 1 (male)

Ke bashanyana, ke e ke bone eka banana ha ba tsotelle haholo.

(Boys. I find girls not to be taking responsibility over their work.)

Student 2 (female)

Ke bashanyana, bashanyana ke e ke bone eka ke bona ba tsebang ho bala, ba lula ba le libukeng nako ena kaofela, rona banana re tsoa re etsa sehlopha mane re bua nthoena le nthoane. Bashanyana bona ba tsoela pele ka mosebetsi oa sekolo.

(Boys. I think boys can read on their own. Most of the time they do their school work, unlike us (girls); we are most of the time in groups gossiping.)

Student 3 (male)

Ke bashanyana, e hlile lithutong tsena tsa mahlale bo abuti ba sebetsa hantle kapa ke hobane ba na le maboko a malelele, ba sebetsa hantle ho feta bo ausi. Ha selemo se fela oa fumana hore ke bona ba sebelitseng hantle.

(It is boys. Boys are brilliant when it comes to the sciences. Even at the end of the year, it is boys who get good passes in science subjects.)

Student 4 (male)

Bashanyana, ha ngata ha sekolo se tsoa u tla fumana hore bona ba sala ba bala, banana e batla e le batho ba ratang menate. Le ka ntlong ea boithutelo oa fumana ele bona ba entseng lerata haholo.

(Boys. Most of the time, boys concentrate on their school work even after school hours whereas girls spend most of their time on fun. It is girls who make a lot of noise during classroom hours.)

Student 5 (male)

Ha ke so ka ke hlokomela, feela ke e ke bone 'science' e thahaselloa ke bashanyana. Mohlomong ka ha ke batho ba mesebetsi ea matsoho, joale ka ha bo ausi ke batho ba ithatelang mesebetsi ea likantorong, ngoanana a ke ke be a hloella palo ea motlakase, ho shebana le mehala ea lifono-fono joalo, joalo.

(I am not aware of that, but boys show much more interest in sciences than girls. Maybe it is because boys like hands-on activities whereas girls like office work. A girl would not climb an electricity pole or to check telephone lines, etc.)

12. Na ho ka ba le phoso ha hore bashanyana le banana ba ka ruto ba arohane? Hobaneng?

(Would it matter if boys were taught on their own and girls on their own? If so (not), why?)

Student 1

Ke bona e ka ba ntho e ntle, banana ba re khathatsa, ke batho ba litaba tse ngata, ba lerata, ... Ha re rutoa re le bang ke lumela re ka sebetsa hantle.

(I think that would be a good idea, because girls are troublesome and noisy and they are involved in many other things.... I think if we could be taught on our own, we can even do better.)

Student 2

E, nka se e rate, hobane nka belaela hore na re rutoa ka mokhoa o ts`oanang na? ...

(Yes, I will mind that, because I will not be sure if we are taught in the same way.)

Student 3

Ke bona ho se na bothata ha re tsoakane feela. Empa kea tseba hore tabeng tsa 'bo-reproduction' banana ba rata hore ba rutoe ba le bang.

(I do not mind if we are taught together, but I know that girls like to be on their own when it comes to topics like reproduction.)

Student 4

Nka se tsotelle haholo, banana ba bapala boholo ba nako, le ha ngata u tla fumana hore bashanyana ba ka tsebang ho u thusa linthong tse ngata, banana bona ha ngata ke bona ba botsang hore na hana ntho e itseng e etsuoa joang. U thole ba re ferekanya ha ngata.

(I would not mind that much, because girls are playful most of the time. Boys are helpful whereas girls might confuse us even more.)

Student 5

Ha e bohlokoa, hobane tlholisano e tla ba sieo. E ntse e le bohlokoa hore re lule re kopane, hobane ke le moshanyana, nke ke be ka thabela ho theoloa ke ngoanana, le ngoanana le eena a ke ke be a thabela ho theoloa ke moshanayana, `me e ba mosebetsi oa sekolo o ba motle.

(I do not think that is a good idea, because we will not be able to compete according to sex. If we compete I think that can enhance our perfomance.)

13. Na sekolo sa heno se nka karolo litlholisanong tsa 'science'? joang?

Haeba ha ho joalo, u ka rata hore se kenele litlholisano tsa mofuta o joalo?

Hlalosa.

(Is your school involved in science competitions? If so, how?

If not, would you like your school to be involved in competitions and why?)

<u>Student 1</u>

Ha ke tsebe. E, nka thabela ha re ka kenela li 'competition' hobane ho na le bana ba bang ba tsebang 'science' haholo, `me ke lumela hore re ka fumana lintlha tsa bohlokoa ha re ka kenela li 'competition. Ha ke bone limpe tsa li 'competition' ke bona lintle feela.

(I do not know. Yes, I would be happy if we could be involved in competitions because there are some students who know science better. As a result, we will get useful information from them. I do not see any disadvantages which might be brought forth by competitions.)

<u>Student 2</u>

Ha ke li tsebe. Feela ho latela tlhalosetso eo u faneng ka eona, nka thabela ha sekolo sa heso se ka li kenela, hobane bana ba sekolo sa heso ke lumela ba ka sebetsa betere. Ha re kopane le ba likolo tse ling ke lumela hore lintho tse ling re ka li fumana ho bona. Ha ke bone bobe boo li 'competition li ka bo tlisang, hore na rea hloloa, re tlabe re ithutile hore na ho etsuoa joang, le rona nakong e tlang re tla ea ruta ba bang hore na ho etsuoa joang.

(I know nothing about competitions, but after the explanations I got from you, I would love my school to be in competitions. They will be beneficial to us and I think we could do better. I do not see any disadvantages when it comes to competing, because even if we do not win, we will have learned, and next time we will be in a position to share that experience with any other school.)

Student 3

E, se kile sa nka karolo, morao tjena ha re sa nka karolo, ke qetetse ha ke bala 'form B', ho ne ho khethoe bana, ba tsamaea ho lo kenela tlholisano ea mofuta oo.

(Yes, we were once in competitions, but we last had that while I was in form B. Some students were selected to go and compete in another school.)

Student 4

Ha ke li tsebe. Ka mor`a tlhalosetso eo u faneng ka eona, nka rata ha sekolo sa heso se ka nka karolo hobane e tla bonts`a bophahamo ba 'science' likolong. Hape likolo li tla sebetsa ka thata hore li tle li hlole.

(I know nothing about competitions. After your explanation, I think I would like my school to participate in competitions because the standard of science will be reflected for competing schools.)

Student 5

Ha ke so ka ke utloa ka tsona. E, nka rata ho nka karolo, e ka ba ntho e monate haholo, hobane re ka etsa boikhathatso ba hore re batle ho hlola... Mosebetsi o ka ba motle haholo. Ha ke bone limpe tse ka tlisoang ke li 'competition', mohlomong ke haeba sekolo se seng se ikaba ka makhabane nako ena kaofela, se nyahamisa se seng. Feela ha ke lumele ho ka etsahala joalo, likolo li ka hlolisana.

(I have never heard of competitions. Yes I would like my school to participate in competitions. It would be very interesting. We will work hard so as to win. I do not see any bad side to competitions; maybe if one school could win all the time, so the other school could get demotivated. Although I think that is unlikely to happen for one school to win all the time.)

4.6 Conclusions

The main conclusions which emerge from the interview results from teachers and students, described above in sections 4.4 and 4.5, may be summarised by saying that teachers were emphatic in calling for more in-service and pre-service training. Students and teachers gave the impression that hands-on activities are seldomly done in Lesotho science classrooms, and that teachers resort to providing students with explanations, because they feel that it is easier. Also it is evident that some schools have laboratory equipment which is not efficiently used, due to laziness or lack of time because of the lengthy syllabi, and so on. Teachers favoured a child-centred approach, rather than lecture and demonstration methods which they claimed to be the most commonly used teaching methods in Lesotho schools.

On the other hand, while teachers seemed hesitant to coach students for competitions, their students liked their schools to be involved in competitions or even inter-class competitions, Both teachers and students perceived competitions to be very important in that competitions raise students' interest. As a result, they will try to work harder, which will probably lead to good results, or even teachers themselves becoming more motivated.

4.7 Chapter summary

In this chapter, the responses given by the three samples were found to be in strong agreement in respect to more than half of the curriculum policy recommendations suggested for Lesotho school science. Among the three samples of respondents surveyed in 1999, statistically significant differences were found to occur from time to time on the curriculum policy recommendations with regard to science teachers' and pupils' priorities for school science curriculum policy suggestions for the Lesotho science teaching context.

Table 4.10 on page 82 summarises, in percentage form, the responses of samples 1, 2 and 3 together, presented as a collective overview of the areas of agreement and disagreement among the science teachers and their science pupils. The correlations r_{12}, r_{13} and r_{23} between the agreement responses of samples 1, 2 and 3 are all statistically significant.

Finally, several newly emerging suggestions, focusing on supporting the science curriculum, were categorised in the last section of the results.

The next chapter, chapter 5, is set aside for a more detailed discussion of all the emergent results, and of their overall trends and of their educational significance for Lesotho in the year 2000.

CHAPTER 5

DISCUSSION AND IMPLICATIONS

5.1 Introduction

In chapter 4, some similarities and significant differences were discovered in the responses of the three samples to the 20-item data gathering instrument. In this chapter, the most important preferences and choices will be discussed and interpreted in terms of recent trends in Lesotho science education and Lesotho government policies. An attempt will be made to suggest possible explanations for the significant differences in preferences for or against certain items.

5.2 Discussion of the theoretical/conceptual model for science education curriculum development issues

Many issues pertaining to science curriculum improvement in the larger context of Solomon's (1998) conceptual framework supported most of the aspects covered in the survey instrument used in this study. The issues which are not covered in the instrument are :-

- Science for the personal development of the individual
  - by enhancing his/her long-term values
  - by enhancing his/her personal growth, feelings and emotions

- Science for its own rational development
  - as a development of historical events and the humanistic utility of science for the economic development of a nation with a specific reference to the international future competitive edge and adaptable, novel retraining of the workforce.

There are some issues which are partially covered in the survey instrument and these are:-

- Science for its own rational development
  - as a logically structured set of concepts, theories, processes,skills evidence, knowledge and limitations, and the humanistic utility of science for the economic development of a nation with specific reference to cultural transmission of knowledge.

The instrument used in this study had twenty items, but in future studies, several items could be added on the issues of long term values and personal growth in science.

5.3 Discussion of selected quantitative findings

5.3.1 Variation in the preferences for particular items, by different groups.

Introducing more real life skills into science (item 1)

A comparison of the responses of samples 2 and 3 (table 4.8 page 80) indicated a highly significant difference for item 1 (Chi-square = 9.45, df = 1, $p<0.01$). The Lesotho high school science teachers considered '*Introducing more real life skills into* *science'* as their best policy preference significantly more than their students. Their reasons for being in favour of item 1 were recorded in section 4.3.1 of the qualitative findings on page 84.

Dlamini *et al.* (1999:1) support their claims with the following statement:-

> " Several studies have focused on the effect of anchoring everyday science into school science on learners' mastery of school science."

The above statement coincides with the tentative suggestion mentioned by Van den Akker (1995: 5) that, in the Southern African context, the following implications for the teaching role do exist:-

> " The idea that learning should be contexualised requires embedding of new knowledge and skills in real-life contexts that fit with situations for application. However, the new knowledge and skills should also be decontexualised and generalised in order to facilitate transfer to other situations. Demonstrations and providing experiences with transfer of new concepts and strategies to other contexts is demanding."

The Report of the National Seminar on Lesotho Secondary Education Policy, Ministry of Education (1995: 7) also noted that:-

> " In recent years, there is another shift to teaching life skills in order to address the current economic, social, cultural, moral and political changes."

The Lesotho high school science students favoured item 1 less strongly. One reason could be that teachers seldom relate what they teach in class to everyday events and students fail to see the relevance of school science to real life problems.

Introducing more gender issues in science (item 2)

Table 4.4 on page 73 records that a significant difference occurred in the responses to item 2, ($p= 0.048$). Whereas 59.7 % of sample 1 (Lesotho high school science teachers) indicated their agreement for this item, only 42.5 % of sample 2 (Lesotho primary school science teachers) did so.

Although the Lesotho primary school science teachers (sample 2) were not as attracted to item 2 as the high school science teachers (sample 1), Taiwo (1999:140) cautions that student motivation is the key factor in encouraging girls to develop interest in mathematics, science and technology (MST). Therefore, it may be necessary to pay special attention in future to the motivation of girls in the realm of MST. This might involve thinking of policies that would specifically target the girl-child in order to encourage more girls to develop an interest in MST. This might serve to remedy some injustices and imbalances of the past. These suggestions were cited to improve the teaching and learning of science in Africa, and they all equally apply to Lesotho.

There is a highly significant difference between samples 1 and 3 for the responses to item 2 (chi-square = 16.11, $p < 0.01$). A greater proportion of the Lesotho high school science students showed agreement with the suggestion of '*More emphasis on gender issues'* in the science education curriculum, compared with their high school science teachers. Lesotho high school science teachers thought that paying more attention to gender issues was not their priority in improving the teaching and learning of science, whereas the other two samples supported the suggestion more appreciably.

In Jefferson, USA, Scott (1999) conducted a research in Hillsboro R-3 school district. He found gender bias in education, and showed that the bias existed against females specifically in the areas of studies concerning science. He further pointed out that the conditions which contributed to this bias were brought about by societal expectations and by the education system itself. He highlighted that girls had always felt the lifelong effects of educational gender bias in their career choices and advancement opportunities, particularly in fields like science. In addition, research has shown that changes in instructional methods to accommodate girls' and boys' learning needs could be effective. He concluded that changes could be made to the curriculum to alter this inequity.

In America, Knuth *et al.* (1991:40) observed that:-

> " In the past, girls have typically not achieved as well in science as boys, although there is no evidence that boys are naturally better at science than girls. On the contrary, studies have shown girls have excellent aptitudes in the skills required to do science. Therefore, schools must provide girls with better access to science courses. This includes squelching the tacit assumptions that girls should not be in science. It also means designing science instruction so that it can build on the experiences of girls as well as boys."

<u>Changing the science curriculum to a compulsory core syllabus plus many options (item 9).</u>

A highly significant difference ($p<0.01$) occurred between the responses of the 368 Lesotho high school science students (sample 3) and the responses of the 94 Lesotho high school science teachers (sample 1) with regard to their agreement with item 9, as recorded in table 4.6 on page 77. 78% of sample 1 agreed with '*Changing the science curriculum to a compulsory core syllabus plus many options*', compared with only 56% of sample 3.

De Feiter (1995:17) observed that :-

> "Although, by using the different syllabus options, one could devise a curriculum policy based on academic ability and interest including different aims for different types of students, the syllabi of the different combinations of subjects are not specifically designed for such purposes..."

De Boer (1991:171) discussed this issue. He pointed out that curriculum makers failed to take into consideration the importance of student interest, personal concerns, or the practical applications. As a result, students developed little interest in scientific study.

Since the kind of curriculum that is followed in Lesotho does not yet address the suggestion made above, this might explain the rejection of this item by the Lesotho high school science students. In other words, Lesotho high school students seemed not to be aware that this kind of curriculum could serve their own personal interests, relevance and pleasure. A study of the sciences is optional at the senior level and students might not believe in this notion of 'science for all'. Perhaps Lesotho science education policy makers might explore this kind of curriculum, as mentioned by De Feiter.

Sharing and increasing the intellectual excitement and sense of adventure which science offers (item 14).

The strong demand for this item as a priority by the Lesotho high school teachers (sample 1) is not shared by their students (sample 3) in table 4.6 on page 77. The apparent lack of congruence between the preferences of young scientists and their adult science teachers could possibly be explained by Tinker (1995:1):-

> " In a rush to include more science content, to prepare students for the exam, educators have lost the essence of science; science education has devolved into a separate entity divorced from science. From kindergarten through college, students rarely **do** science, they seldom see the creative side of science, they do not feel it is open-ended or belongs to them. " High adventure" is rarely an apt description."

On the other hand, Baird (1998:159) warned that, if students feel challenged by what they do, they tend to learn actively. Woolnough (1994:13) cautioned that students should enjoy their science and thus obtain a better appreciation of the wonderful world in which they live. He further highlighted that, for many who did not follow a career in science beyond school, their enjoyment and appreciation of science was also determined by their science teacher (p.45).

If Lesotho is to achieve new science standards, then she needs to convert these experiences into classroom practices. However, Van den Akker (1995:46) characterised classroom practices in Lesotho as overdependent on the lecture method ('chalk and talk') which is in contrast with the intended student-centredness of instruction.

5.3.2 Congruence in the selection of the best policy choice among the three samples.

A large measure of congruence was found in the best policy choices of the three samples of Lesotho high school science teachers, Lesotho primary science teachers and the Lesotho high school science students.

Acquiring more resources for schools in Lesotho (item 15)

Table 4.1 on page 63, table 4.2 on page 66 and table 4.3 on page 69 indicate that all three samples tended to favour '*Acquiring more resources for schools in Lesotho*' most strongly. The recommendation agrees with the results obtained by Talukdar (1995a:3) on the aims that textbooks, laboratories, audio-visual aids etc. were the common source of information and very useful for classroom instruction. Appleton & Kindt (1999:155) also agreed that lack of resources could result in a topic not being taught properly.

On the other hand, as found in my interviews Appleton & Kindt warn against the failure to use resources properly. They may be available in the school but, if poorly organised, they will be ineffective in the teaching and learning of science. Lunetta (1998:249) also reported that, from the early 19th century, laboratory activities were reported to assist students in making observations about the natural world which provide a basis for inferences based on that information. He further highlighted that laboratory activities offer important experiences in the learning of science that are not present in other school disciplines.

The reasons given by the respondents for choosing item 15 as their priority in the teaching and learning of science are mentioned in section 4.3 on page 92 . Most of them concur with the following reasons given by Lunetta (1998: 249) for promoting central science education goals:-

- Students understand scientific concepts;
- They develop scientific practical skills;
- They develop problem-solving abilities; and
- Their interest and motivation increase.

Encouraging more competitions in science (item 7).

The research findings suggest that all three samples in Lesotho also tended to strongly prefer '*Encouraging more competitions in science*'. In England, Woolnough (1994: 78) highlights that competitions add extra spice to the activity and they are more fun. They can do wonders for students' morale, motivation and self-confidence; and these justifications also coincide with the reasons given by the Lesotho respondents in section 4.3 on page 88.

More cautiously, on the other hand, Woolnough (1994: 109) believes that there are three principles underlying the effectiveness of competitions in school science, viz.:-

- As intrinsic motivators, competitions should only be used as secondary goals in relation to the intrinsic motivation that comes from the worth and enjoyment of the science activity itself.

- Competitions will be a positive stimulus to good work only if the students stand a better chance of succeeding.
- If a student has no chance of success in a competition, such competition will be counter-productive.

These cautionary principles, or caveats, are consistent with the reasons mentioned in section 4.3 on page 88 by the Lesotho respondents who dissented against this item.

5.4 Discussion of the qualitative findings

Many suggestions emerged in the open-ended section of the survey instrument. These were categorised accordingly in section 4.3.1 on page 94, viz.: learner support services, teacher support services and more resources.

<u>Teacher support</u>

The sample of teachers recommended that there is a need for regular science workshops, seminars, more intensive in-service training for professional development, and for part-time studies to equip science teachers with modern approaches and techniques of teaching science.

The Education Sector Development Plan, Ministry of Education (1991/92-1995/96: 81) envisaged that the following three main thrusts would be pursued with regard to the teaching force:

" (i) to expand the teaching service systematically according to plan targets;

(ii) to enhance teacher quality; and

(iii) to lower attrition and raise morale by improving conditions of service for teachers."

The Report of the National Seminar on Lesotho Secondary Education Policy, Ministry of Education (1995: 5) was also in harmony with the efforts to be made to strengthen teacher support services. In particular, there was a need to establish an attractive career structure for teachers; to improve the in-service training; to foster staff development; constantly to review teachers' salaries and other incentives, e.g. hardship allowances; and constantly to align teachers' salaries with the inflation rate.

In addition to the above recommendations, Talukdar (1995a: 6) emphasised that the Government should devise mechanisms to give additional allowances or benefits to teachers. He warned that science graduates in other sectors of the national economy received a higher salary. This resulted in teachers moving away from the teaching profession into non-teaching jobs. He concluded that this tendency needed to be attended to, to reverse the movement, so that Lesotho schools could attract better people into teaching.

Since Talukdar's recommendations in 1995, the evidence gathered in this 1999 study continues to emphasise that, in order to improve Lesotho science teachers' morale considerably, the recommendation strongly calling for increased teacher support needs to be the first priority for improving the state of science and technology teaching in Lesotho schools in the year 2000.

Resources

The Education Sector Development Plan, Ministry of Education (1991/92-1995/96:40) reported that the inefficiency and poor quality characteristic of Lesotho's primary schools were brought about by a combination of overcrowding, poor teaching, insufficient teaching materials and inferior management. It also pointed out that physical facilities in many primary schools were inadequate, classes tended to be very large, there was high percentage of unqualified teachers; and an examination-driven curriculum was combined with a shortage of instructional materials for pupils. Thus, the plan aimed at increasing the low level of resources to pupils in standards 1-3, with the aim of bringing about substantial improvements in quality and efficiency throughout both the primary and secondary systems.

On the other hand, Talukdar (1995a:3) indicated that schools had not developed a system of maintaining laboratories at a reasonable level. The funds for the laboratories were insufficient; nor were they utilised meaningfully and economically. Even if the equipment and materials were donated to schools, the local authority could not even properly store them. Consequently, Talukdar (1995a:6) suggested that the

Government should: formulate a policy of publishing and supplying educational books at a cheap price; try to encourage local writers to write books; set up printing and publishing technologies; develop a structure for marketing educational books cheaply; sign agreements with foreign publishers to publish books locally; set up a better network of public and school libraries, and ensure that they were maintained at a reasonable standard. Such expenditures should be catered for in the yearly national budget of the country.

The Report of the National Seminar on Lesotho Secondary Education Policy, Ministry of Education (1995:21) also suggested that the Government should subsidise books for secondary education, as it does for primary education. Furthermore, there should be a policy on the construction of laboratories and workshops; and on the supply, use and maintenance of equipment.

These earlier recommendations concur with the findings in this study, in which both teachers and students suggested a priority need for the government or authorities to seek additional sources of finance as the foremost concern.

Learner support services

In their recommendations, the sample of Lesotho teachers expressed a need for career guidance to be supplied to the Basotho children; and a need to revisit the scholastic admission requirement to the higher classes or institutions. The teachers' concern was that some academic entry requirements hinder students - who might, in the future, perform excellently in science - from proceeding. Students are required to obtain a pass in English to qualify for their Cambridge Overseas School Certificate (COSC), and a second class pass in English to gain admission to the University.

In his study of the effectiveness of secondary education sector study, McMurchy (1997:4) pointed out that, of the 3, 401 students that wrote the COSC Cambridge examination in 1991, only 1,844 (54.2%) passed English. Of these, 18 obtained a first class pass, and 64 reached a second class pass level. Seemingly this could be the situation even today, or even worse, as the performance in English has been declining sharply over the years:-

Nenty (1999:43) observes:

> "The humanpower development problem, especially in the areas of science and technology, stemming from the use of a foreign language as the language of instruction in Lesotho schools, is fast becoming a national crisis. For example, the admission requirement of a credit in English had to be waved for an internal qualifying examination in English in the 1999/2000 admission exercise of the National University of Lesotho... or do a good job by ensuring that learners have a good grasp of English very early in their formal educational experience. Whatever decision is reached would call for serious commitment on the part of all the stakeholders in terms of policy, teacher training, instructional practices, and the provision of essential resources."

Recommendations from the Lesotho teachers surveyed in this study included more learner support programmes, like career guidance. It is my belief that the knowledge and skills imparted in some tertiary institutions might under-emphasise the importance of career guidance. For teachers to provide that kind of support needed by their students, the provision of such in-service programmes must become a priority in the educational institutions.

5.5 Discussion of the best/least preferred recommendations: responses from the three combined groups on the 20-item instrument

Table 5.1 on page 158 combines and presents the 1999 best/least policy responses obtained from sample 1 (table 4.1 page 63), sample 2 (table 4.2 page 66) and sample 3 (table 4.3 page 69) to give an overall record of highly prioritised recommendations. The main consensus recommendations from the 549 experienced primary science school science teachers, high school science teachers and their science students are focussed on items 15, 7, 19, 8, 10 and 16, in that order of preference.

These recommendations are also embodied in the Report of the National Seminar on Lesotho Secondary Education Policy: Localisation of the O'level curriculum, Ministry of Education (1995). The report contains a summary of the closing speech by the Principal Secretary of Education (Dr.T.G.Khati) who indicated that the localisation of O'level curricula and examinations should emphasise the idea of education for life, and should offer relevant knowledge, skills and attitudes that foster education with the production and development of creative faculties. Therefore, it is highly possible that these recommendations will remain a curriculum priority for the improvement of teaching and learning of science in Lesotho (p. 18-30).

Table 5.1: The best/least policy preferences of the three samples forming a total combined group of 539 high school science teachers, primary school science teachers and students in Lesotho in 1999.

Suggestions for improvement	**Frequencies of occurrence (N= 539)**	
	Best recommendation	**Least important recommendation**
1. More real life skills in science	43	20
2. More gender issues in science ♦	07	**99**
3. More environmental issues	37	47
4. Science for community development	19	59
5. More attention to language ♦	18	**134**
6. More focus on the disadvantaged	11	34
7. More competitions in science *	**97**	33
8. More self-discovery in science *	**85**	23
9. Core plus options curriculum	26	61
10. More primary school science *	**80**	63
11. Wider community consultations	08	44
12. Computer-aided science	56	54
13. Promoting careers in science	34	26
14. Excitement and adventure	14	21
15. Acquiring more resources *	**186**	24
16. Conducting science campaigns *	**75**	36
17. More extramural science activities	54	22
18. External support and recognition	22	27
19. Better teaching methods *	**92**	34
20. Science as an entry requirement ♦	12	**75**

♦ Least favoured policy preferences

* Best policy preferences

5.6 General comment on undiscussed items

In this study, the congruent patterns of responses are consistent among the samples on the choice options of item 19 '*Introduction of better teaching methods*', item 16 '*Conducting more science campaigns*' and item 1 '*Introduction of more real life skills into science*', as the better favoured policy recommendations; and in respect to the relatively low preference allocated to item 5 '*Paying more attention to language issues*' and to item 2 '*Paying more attention to gender issues*' among the twenty policy alternatives for improving the teaching and learning of science in Lesotho high schools by the year 2000. However, the low ratings given to items 2 and 5 might be a consequence of a concern about the translation of the English science terminology into Sesotho, as the meaning may be lost and gender not considered to be so important in the acquisition of science skills.

Many respondents seemed to take an opposing view on the choice options of item 3 '*Concentrating more on Lesotho environmental issues*' and item 4 '*Using science to advance and develop the Lesotho community socially and economically*' (see table 5.1). The reasons for their view might be the fact that school students, and to a lesser extent their teachers, had little exposure themselves to environmental issues during their learning of subjects like biology and geography. As a result, students are unaware of the role played by everyday activities in Lesotho such as using electricity from coal-fired power stations, the problem of soil loss, damage to the ozone layer and a reduced concern for the conservation of plants and animal species. With the poor state of the country, it might not be practicable to develop the Lesotho communities using science, as this might be costly. This might account for the high rejection of item 4.

Furthermore, the relatively low preference given to item 6 which recommends '*Having the underprivileged majority at its focal point*' might be caused by students and their teachers feeling that that is being too ambitious to expect science education to empower Lesotho communities to address their local problems resourcefully. Vital stages, such as situational analysis, monitoring and evaluation of such areas are currently neglected in the development of the national curricula. This might as well explain the relatively low preference given to item 11 which calls for '*Wider community consultations*' on how to improve the teaching and learning of science.

On the other hand, in table 5.1, it is recorded that many respondents view item 10 '*Giving all pupils in Lesotho primary schools much more basic science*' as a strong recommendation. Primary education forms an important foundation for socio-economic development of the country. Since primary teachers do not specialise, many of them might not be sufficiently competent to teach the detailed content aspects of science, although they could have received thorough training in methodology. This might be a possible reason for so many respondents favouring this particular item.

In addition, the respondents seem to be evenly polarised about the importance or unimportance of item 12 which proposed '*More computer-aided instruction in science*'. Out of 200 secondary schools in Lesotho, only 14 schools have computers

(UNESCO workshop on sensitization on computer in education, 1996:1). In the light of this, possibly many students remain computer illiterate, perhaps unlike their teachers who might have been exposed to the world of computers in higher education. I suspect that both students and their teachers still generally consider the use of computers in Lesotho science classrooms as a 'dream', as computers are very expensive.

Lastly, the respondent sample views item 13 '*Promoting careers and job prospects in science among school pupils in Lesotho*' as of some importance. A reason for this might possibly be that science teachers are not qualified to teach career guidance, and therefore students tend to be unaware of specific opportunities available in the fields of science and technology. On the other hand, utilisation of '*Better teaching methods*' (item 19), '*Having more extramural science activities*' (item 17) and '*Making more use of self-discovery and self-teaching*' (item 8) (see table 5.1) are prominent recommendations. This might possibly be a consequence of teachers relying too much on lecture and question-and-answer methods than on other methods. My impression is that teachers do not engage in practical and hands-on activities on a regular basis; instead pupils tend to be provided with explanations by their teachers. On the other hand, the low preference given to item 20 '*Considering science as an entry requirement*' might be that those students who are not scientifically orientated might be denied their chances to further their studies in their areas of interest.

5.7 Discussion of the interview data

The findings showed coherence between the students' and teachers' responses in the questionnaire and their responses in the interviews with respect to *'Acquiring more resources'*, *'Having better teaching methods'* and *'More competitions in science'*. However, three students indicated that they have no idea what competitions are all about, which might mean that they just appreciated them on paper. On the other hand, their teachers appeared not to be confident enough as to whether there will be enough manpower to prepare students for competitions or if teachers out there have the skill.

Concerning the teaching methods which are commonly used in Lesotho science classes, the teachers claimed to be using the lecture method and demonstration, of which numerous reasons were given for avoiding other teaching methods. Teachers stated that some teaching methods are expensive, i.e. field trips. They commented on lack of equipment; the type of training they had, which was geared towards lecturing and demonstration; lengthy syllabi, etc. These reasons might seem to be valid, but one of the teachers indicated that even the lecture method, that they seem to believe in, is not used effectively.

Despite this, another teacher highlighted that the information he received from reports by inspectors revealed that schools which have laboratory equipment do not use it efficiently and it is dusty. In addition, science laboratories are used as store rooms for agriculture and sports equipment. It is possible that even the demonstration method which teachers claim to employ is not utilised effectively, or is done well on rare occasions. This might be supported by the information provided from three students who stated that they have never been to the laboratory since the beginning of the year, and who showed eagerness to be taught science through hands-on activities. Thus, it appears that participant observation should have been incorporated into this study, so as to seek first-hand information from the respondents, to get a clear picture of what is really happening in schools.

A need for more resources emerged as the first priority in the questionnaire data. It is possible that teachers might have been aware of the inefficiency in the use of resources in schools but were restricted by the wording of the instrument used then. The interview data also indicates that some teachers are still not confident enough that, if resources could be acquired for Lesotho schools, then the teaching and learning of science could improve because, among other things, they indicated their need for assistance in the proper usage of resources. Nonetheless, teachers persistently showed a need for more pre-service and in-service training, and for more workshops, which need was also reflected in the questionnaire data.

Ultimately, then, we must seek answers to several questions. Why is it that teachers do not maximise the effectiveness of teaching methods with which they seem to be comfortable? Does it mean that teacher training programmes should be appreciably changed? Is it true that resources might be an obstacle to effective ways of teaching science?

The interview data also revealed that teachers and their students do use both Sesotho and English in their science lessons, although they claim to use Sesotho rarely. This might offer an explanation for the high rejection of the item on '*Concentrating more on language issues*' in the questionnaire data. There is a clear indication that teachers do not use English strictly as their mode of instruction, which might mean that there are those who use more of Sesotho in their science lessons.

When it comes to '*Gender issues*', three out of five students emphasised that they would mind if girls could be taught separately from boys and one of them was aware that girls like to be taught on their own when it comes to topics like reproduction. So, I wonder if this might imply that there are cases where girls, or even boys, do not feel at ease when dealing with some topics together in science lessons.

5.8 Other related research findings

Four diverse samples of respondents were surveyed by Rochford *et al.* (1996) across the Republic of South Africa. Their sample comprised 302 respondents. One policy recommendation which was top-ranked by the three samples was '*Introducing more real life into science*' and the fourth sample ranked it as their second priority. All the four samples rated attention to *gender* and *language* issues as being of less importance in the teaching and learning of science, which is consistent with the findings obtained in Lesotho in 1999.

In a survey conducted by Rochford and Lose (1998) in Cape Town among a community of 91 Xhosa science/technology teachers and students, important emerging needs identified by the 47 Xhosa science students were '*More learner support in science lessons' and 'More applied science excursions'*. On the other hand, 44 *Xhosa* science teachers strongly advocated '*Introducing more real life skills in science'* and *'Making more use of self-discovery and self-teaching in the learning of science/technology*'. Both samples gave a low priority to '*Paying more attention to gender issues*' and '*Introduction of a compulsory core plus freely chosen science/technology options*'.

Rochford *et al.* (1997) surveyed five diverse samples of science-engineering-technology lecturers, teachers and students, comprising a total of 704 respondents across the Republic of South Africa in 1996 and 1997. The respondents consistently highly prioritised making improvements by '*Introducing more real life skills into science, such as technical, trade, industrial, commercial, manufacturing, marketing and technology skills'*; and by '*More self-discovery in science'*. There was also a low preference for item 5 which recommended paying more attention to *language issues*, *technical terms*, *word meanings* and *scientific English* as a secondary language. This is also consistent with the findings in Lesotho in 1999.

Sokopo conducted three surveys in 1997. The sample comprised 134 Setswana-speaking science teachers, 200 Expo science students in Pretoria and 75 Expo science students in Cape Town. The recommendation mostly favoured by the three samples was '*Providing more real life skills in science*'. In addition, students considered '*Making more use of self discovery in science*' as a priority. All three samples rated paying more attention to *language* and *gender* issues as their least important recommendations, which is a finding consistent with the responses of the Lesotho science teachers and students in 1999.

5.9 Chapter summary

A discussion of both the empirical and the qualitative results reported in **chapter 4** has been presented in this chapter. An attempt has been made to account for significant differences and similarities which were found among the samples. General comments have been made on undiscussed items. Other related research findings, which have been emerging out of parallel studies in science, engineering and technology education in Africa during 1996 –1998, have been discussed and linked with the results from this study.

Chapter 6 will now draw conclusions, and recommendations will be made for further research.

CHAPTER 6

RECOMMENDATIONS AND CONCLUSION

Based on the findings of this study, the evidence suggests a variety of steps that teachers, curriculum developers and policy makers might take to remedy the difficulties identified in Lesotho. Altogether, fourteen recommendations are made:-

6.1 Recommendations with regard to science and technology teaching and learning in the classroom

Recommendation 1

More real life skills - in the fields of nutrition, health, agriculture, technical, trade, commercial, manufacturing and marketing skills - could be identified and incorporated into the 2000 science curriculum for Lesotho schools. Teachers could expose learners to more concrete examples taken from the learners' experiences in their own communities.

Recommendation 2

Learners could be given more opportunities to discover things on their own, and to be shown how to plan their own investigations and carry out more practical work. They therefore need specific coaching that helps them to select, and to organise and understand methods of independent scientific investigation in groups, or as individuals.

Recommendation 3

The government - through the National Curriculum Development Centre (NCDC), in collaboration with the resource centres - might encourage, motivate, train and reward teachers who use locally available materials for teaching science each day in their classes.

Recommendation 4

More competitions in science should be encouraged in and between Lesotho schools, as they are perceived by school pupils to be potentially beneficial.

6.2 Recommendations with regard to teacher pre-service and in-service training

The effective implementation of the above recomendations depends on the quality of the skills possessed or acquired by Lesotho teachers. It is therefore recommended that:

Recommendation 5

Science educators in colleges or universities should ensure that pre-service and in-service student teachers are trained in such a way that they are able to conduct lessons with special emphasis on more frequent use of real life skills and practical examples in science and technology.

Recommendation 6

The pre-service and in-service training of teachers could also be designed to include more use of guided discovery in science and technology.

Recommendation 7

The pre-service and in-service training of teachers might be re-modelled by designing activities which use alternatives to the sophisticated equipment and materials which are traditionally part of science. Instead, the use of locally available materials could be promoted in science teacher training in Lesotho.

Recommendation 8

Pre-service and in-service training courses should provide teachers with skills on how to design, manage and monitor school and inter-school competitions in science and technology.

6.3 Recommendations with regard to science education policy in Lesotho

Recommendation 9

Considerations could be given to finding ways of helping primary science teachers to adopt a science-technology-and-society approach to teaching science.

Recommendation 10

The Lesotho government, industries, churches and non-governmental organisations might help in allocating funds for science campaigns, the construction of laboratories, workshops and the maintanance of equipment.

6.4 Recommendations for future research

Recommendation 11

For further research, another new survey instrument might be developed with one special, detailed item focussed on '*Acquiring more resources in Lesotho'*. Respondents should be invited to provide a prioritised list of resources that need to be supplied for their science classrooms in Lesotho schools. Furthermore, all participant respondents should be invited to suggest effective ways in which those resources could be best utilised.

Recommendation 12

This study was based on relatively small-scale research. Hence, it is suggested that a broader study might be carried out in the excluded Lesotho districts for more generalisable findings. It is further suggested that the 20-item questionnaire might also be translated into Sesotho if additional surveys are to be conducted at junior/senior high school level.

Recommendation 13

The overall findings are generally consistent with those obtained from parallel samples of respondents speaking other African languages in diverse regions of the neighbouring Republic of South Africa. This study has shown the 20-item instrument to be a convenient method for gathering succinct data. However, this does not necessarily imply that the 20-item survey instrument should remain indefinitely in a static format for gathering information in years to come. It is suggested that more policy recommendations than those suggested to date may be required in future, in the light of the emerging debates in upgrading and reskilling of serving teachers in science and technology and the establishment of best practices in the teaching of science and technology.

Recommendation 14

The writer's published work (Moru and Rochford, 1999a) has resulted most recently in the writer's 20-item survey instrument in Lesotho being replicated, with local modifications, in another developing country - Turkey. A sample of 172 Turkish respondents in science education (19 Turkish university lecturers, 7 Turkish middle school science teachers, 87 Turkish university science students and 59 Turkish senior high school science students) have now completed the Turkish equivalent of the Lesotho questionnaire in the year 2000. Appendix 3c summarises the overall table of preliminary responses obtained from the Turkish sample (N=172). Since many of the patterns discovered in Lesotho appear to be reflected in the trends currently identified in Turkey, it is recommended that this study, designed for use in developing and emerging nations, might now be extended and developed further afield, on other continents.

6.5 Conclusion

From the findings of this study, it is concluded that, '*Acquiring more resources for schools in Lesotho*', '*Encouraging more competitions in science*'; *and 'Having better* *teaching methods*' have emerged as being perceived as the most critical issues for improving the teaching and learning of science in Lesotho high schools. As recorded in section 4.3.1, the responses given by the three samples suggest a need for *more learner support*, *more teacher support* and *more resources*. However, Talukdar (1995a: 3) cautioned that the country also needs dedicated researchers and sincere workers to address these kind of issues.

In support of this, Vonk and Kapteijn (1995: 41) indicate:

> "Governments, however, in their pursuit for (sic) the improvement of science and mathematics teaching nation-wide, are facing the dilemma of how to foster commitment and ownership at the local level on the one hand, and ensuring a nation-wide implementation of successful interventions on the other hand. Research on effective professional development shows that for successful changes in education one should foster ownership and commitment and leave responsibilities for the implementation were (sic) they are really taken, i.e. with the teachers and the school".

Bayer and Shotter (1998:22) suggested that:

> "teachers must turn their critical gaze back upon themselves as a means of assessing the context which...constrains their own discursive range."

On the other hand, Tinker (1995:3) observes:

> "... The number of teachers who work in research labs, Earth expeditions, and the like, need to be greatly expanded and then supported by new programs that convert their research experience from simply a good background exposure into classroom activities and ongoing student inquiry."

Nevertheless, the findings recorded in this study appear to be worthy of closer consideration by curriculum developers, and by teachers in both primary and high schools.

POST SCRIPT

After my investigation in Lesotho identified a great need for more resources, a similar finding has now just been documented in South Africa by Chisholm's (2000, vi-viii) Report of the Review Committee on curriculum 2005, dated 31st May.

The Report of the Review Committee was prepared to review existing South African research reports and papers, interviews with teachers, principals, managers, trainers, publishers and departmental officials, as well as public submissions made by a range of individuals, organisations and institutions. In addition, the Report was based on the view that a curriculum should be geared towards personal and social development and transformation for the 21st century.

The Review Report showed that there were some important areas which were overlooked in Curriculum 2005 (C2005). These were:-

> "Inadequate orientation, training and development of teachers.
>
> Learning support materials that are variable in quality, often unavailable and not sufficiently used in classrooms.
>
> Shortages of personnel and resources to implement and support C2005."

In order to address these issues, the Review Committee has proposed a new revised curriculum that will reflect on a need for high production of learner support materials – especially textbooks - as one of the objectives.

These issues concur with what the writer herself has found in Lesotho; namely, there was an indication that there should be more intensive in-service training for Lesotho science teachers. The interview data revealed that well equiped laboratory facilities and textbooks are also considered to be high priorities for Lesotho schools, as in South Africa.

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APPENDIX 1

A copy of the writer's published research articles which disseminate the results and findings presented in this dissertation

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SAQA and NQF policy issues in the design of a new professional curriculum for science teacher education: a statistical comparison of the policy priorities of 539 science teachers in Lesotho and in five South African provinces from 1996 to 1999

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ABSTRACT

During 1995 a review of the science education policy literature disclosed at least fourteen possible recommendations for improving the current qualification programmes and science curricula relevant to science teacher education training, development, curriculum and up-grading. By 1999 these suggestions had increased in number to twenty. The most recent findings from Lesotho are incorporated into the conclusion of this report on a common study which has extended over six regions of Southern Africa. Against the unfolding release of details of suggested SAQA policies, the investigation surveyed 49 experienced urban science teachers and lecturers in Cape Town and Johannesburg; 205 rural science teachers-in-training (home language Xitsonga) at a college of education in the Northern Province; 114 experienced rural high school science teachers in the North West Province, of whom 96% speak Setswana as their home language; and 77 experienced primary and 94 experienced secondary science teachers in Lesotho. The priority findings of this study suggest that a policy for the curriculum design of a professional qualification in science teacher education for Southern Africa, for the year 2000, might be appropriately focused on the key issues of: coping mechanisms for working effectively in under-resourced schools; acquiring and using better science teaching methods ; skills in applying science to real-life situations in teacher training programmes; and learning how to foster and encourage more independent learning by pupils in schools.

INTRODUCTION

In their re-appraisal of assessment practices in the light of the South African Qualifications Authority Act, Sutherland and Peckham (1998) point out that teaching staff need to cope with increasing numbers of inadequately prepared students, decreased resources, and increased use of computer-aided assessment. The paradigm suggested by SAQA has a formative focus for learning, as well as a summative one: it fosters a variety of instructional methods; it encourages deep learning; it emphasises critical thinking and higher order thinking skills; and it specifies the diagnosis of learning problems at an early stage in students' progress.

The SAQA Bulletin (1997:15) mentions several assessment methods such as portfolios, simulations and in situ work-place assessments related to real-life situations.

Clearly, these recent policy developments have implications for the university curriculum and training of both Lesotho and South African science teachers: so the findings of a three-year study of the policy preferences and priorities of a total sample of 539 science teachers in six regions of Southern Africa, from 1996 to 1999, are reported in this article, both within and beyond the context of the paradigm policies suggested by SAQA.

BACKGROUND

The unfolding and development of curriculum 2005, and the formulation of the SAQA paradigm, has occurred in the context of the goals of the Reconstruction and Development Programme (Ndebele 1996).

These initiatives flowed from the *White Paper on Education and Training in a Democratic South Africa: First Steps to Develop a New System*, which the Government of National Unity released on 15 March 1995.

In its statement of *Values and Principles of Education and Training Policy*, the White Paper stated that an appropriate mathematics, science and technology initiative is essential to make up the chronic national deficit for economic advancement.

In this statement of *Values and Principles of Education and Training Policy*, the White paper (1995) advocates

> 18. Curriculum choice, especially in the post-compulsory period, must be diversified in order to prepare increasing numbers of young people and adults with the education and skills required by the economy and for further learning and career development.
>
> 19. An appropriate mathematics, science and technology education initiative is essential to stem the waste of talent, and make up the chronic national deficit, in these fields of learning, which are crucial to human understanding and to economic advancement.

It is in this context, and against the above background, that the findings reported in this paper are presented.

PURPOSE

In 1995 a survey was made of the local and international science/technology education literature (see Appendix A, references 1 to 31) by a team of seven postgraduate research students and staff at the University of Cape Town. This review disclosed fourteen categories of recurring recommendations for improving current curricula, teaching methods and textbooks in programmes of science/technology; and which then remained substantiated by the current literature of 1996 and 1997 (see Appendix A, references 32–40). Many of these context-based recommendations in the literature were also consistent with the more generalised emerging policy suggestions of the NQF (see Appendix B).

The purpose of this investigation during the initial period of May 1996 to May 1997 was to determine which of these fourteen possible recommendations for the improvement of current programmes of science/technology would be mostly highly prioritised and agreed upon by the diverse samples of South African lecturers and teachers in science/technology education.

These fourteen science education policy recommendations incorporated and contextualised many of the features emerging, at the time, as part of the unfolding development of the characteristics of the SAQA paradigm; for example, the emphasis on authentic assessment practices, rather than decontextualised assessments; deep learning rather than surface learning; critical thinking and higher order thinking skills; self-referenced criteria; variety of methods; integrated rather than isolated learning; student-led assessment; the formative and developmental nature of learning; intrinsic motivation; serving the needs of the student; learning outcomes; educational decision making; assessment as part of the students' learning processes; computer-assisted learning; collaborative assessment; students' responsibility for their own learning; and use of simulations and in situ workplace assessments and real-life situations (Sutherland & Peckham 1998).

In 1999 the scope of this investigation was extended to primary and high school science teachers of Lesotho, with an increased number of policy recommendations as choices, in the light of the emerging debates on the appropriateness and feasibility for Southern Africa of important aspects of the NQF, SAQA and Curriculum 2005 proposals.

INSTRUMENT DEVELOPMENT AND OBJECTIVES

Developmental pilot studies of potential instruments occurred using critical research groups of postgraduate science and technology teachers in small-scale trials. Fourteen categories of policy recommendations were carefully worded and selected as being immediately relevant to South African science/technology education, and to the principles and values stated in the Government White Paper. In summary form, these recommendations (referenced) were as follows:

1. Introducing more real-life skills into science/technology (Appendix A, 1–6).
2. Paying more attention to gender issues (Appendix A, 1; 8; 9).
3. Concentrating more on South African environmental issues (Appendix A, 3; 7; 10–13).

4. Using the sciences to advance and develop the community socially and economically (Appendix A. 1; 4; 7–9; 14–17).
5. Paying more attention to language issues (Appendix A. 1; 8–9; 18–20).
6. Having the disadvantaged South African majority as its focal point (Appendix A. 1; 8; 14; 15; 21).
7. Encouraging more science competitions (Appendix A. 14).
8. Making more use of self-discovery and self-teaching (Appendix A. 3; 7; 9; 21–24).
9. Changing the curriculum to a compulsory core plus options (Appendix A. 1; 8; 9; 17; 25; 26).
10. Giving pupils in primary schools more basic science and technology (Appendix A. 14; 17; 27).
11. Consulting all interested groups in the community (Appendix A. 1; 8; 17; 24; 28).
12. Using computer-aided instruction as part of science (Appendix A. 29; 30).
13. Promoting science/technology careers among school pupils (Appendix A. 4;9; 15; 17).
14. Sharing science's intellectual excitement and sense of adventure (Appendix A. 7; 31).

A suggestion that the learning of science might best be improved through African indigenous technology and culture, and through the African world view of life and thought system, received relatively little support, and was subsequently deleted from the questionnaire.

The first items required respondents to say whether they *agreed* or *disagreed* with each of the fourteen suggestions offered for improving school science/mathematics/technology programmes. The final two items requested the respondents to focus on, and select, the *two best* ways for improving science/mathematics/technology curricula in the new South Africa; and to identify the *two least important* recommendations of the fourteen.

In 1998 test/re-test reliabilities of the instrument, using the first 14 items, were found to be from $r = 0.88$ to $r = 0.97$, using samples of $N = 47$ and $N = 14$ respondents over periods ranging from seven days to seven weeks.

In 1999 the survey instrument was expanded from fourteen to twenty items, appropriate for the Lesotho science teacher training context (Ministry of Education 1981; Calloids 1999). A copy of the Lesotho survey questionnaire is attached in Appendix B.

METHODOLOGY

During the period of May 1996 to May 1997, the instrument was administered to three convenient samples of science teachers, from north to south of the Republic, comprising a total of 368 respondents.

Sample 1 consisted of 49 urban BE/BSc graduates from Cape Town and Johannesburg specifically committed to engineering, technology or science education as a career.

Sample 2 consisted of 205 teachers-in-training specialising in high school science at Giyani College of Education, in the Northern Province of South Africa, 80% of whom speak Xitsonga as their home language.

Sample 3 consisted of 114 rural high school science teachers from the North West Province of South Africa, of whom 96% speak Setswana as their first language.

Sample 4 consisted of 94 urban/semi-rural high school science teachers in Lesotho. About 98% speak Sesotho as their first language. The distribution of males and females was even, and they were approximately within the age range 23–60 years. They were surveyed in April-May-June 1999 in Lesotho.

Sample 5 consisted of 77 Sesotho speaking primary science teachers. About 100% speak Sesotho as their first language. There were more females than males, and they were within the age range 22–60 years. They were surveyed in April-May-June 1999 in Lesotho.

THE SURVEY RESEARCH METHOD

Survey sampling is the research method that has been employed in this study. This appeared to be the most appropriate research method which could be used to gather data from relatively large numbers of cases at a particular time (Ary & Jacobs 1975:25). Fink and Kosecoff (1985:5) regard it as a rediscovered strategy suitable for science education research.

DATA COLLECTION

Data was collected in 1996 from experienced science/technology/engineering teachers and lecturers during four invited seminar presentations at three universities and at one technikon; and from the science teachers in the North West Province in 1997 by the normal correspondence system used by the education circuit managers. In the Northern Province the data was collected at scheduled times in the Giyani College of Education. In 1999 the questionnaires were administered during the normal science teachers' meetings held at the resource centres in the various districts of Lesotho in April-May-June. The use of the resource centres was limited so the first author also moved from school to school, giving smaller groups of science teachers the questionnaires to complete during their spare time. Then the questionnaires were collected after three to four days. Permission was sought from the principals.

FINDINGS

Tables 1, 2 and 3 present the data obtained for the responses from the five samples of surveyed science teachers.

Table 1

Congruence between the policy agreement of samples of 368 urban and rural South African science/technology lecturers and teachers

Suggestions for improvement	Graduate S-E-T teachers & lecturers, metro-politan (N=49)		Tsonga-speaking rural science teachers-in-training (N=205)		Setwana-speaking rural science teachers (N=114)	
	Agree	Disagree	Agree	Disagree	Agree	Disagree
1. More real-life skills in S-E-T	48	0	196	9	111	3
2. More gender issues in S-E-T	19	28	117	88	37	77
3. More environmental issues	46	2	153	52	86	28
4. S-E-T for community development	37	8	150	55	96	18
5. More attention to language	40	8	106	99	56	58
6. More focus on the disadvantaged	32	10	138	67	91	23
7. More competitions in S-E-T	30	14	168	37	108	6
8. More self-discovery in S-E-T	45	3	196	9	111	3
9. Core plus options curriculum	31	12	158	47	88	26
10. More primary school S-E-T	39	8	200	5	111	3
11. Wider community consultations	31	13	176	29	103	11
12. Computer-aided instruction	36	10	174	31	109	5
13. Promoting careers in S-E-T	45	3	190	15	109	5
14. Excitement and adventure	46	0	178	27	109	5

Table 2

Congruence between the policy agreement of samples of 77 Sotho-speaking primary science teachers and 94 high school science teachers in Lesotho in 1999

Suggestions for improvement	Lesotho primary teachers (N=77)		Lesotho high school science teachers (N=94)	
	Agree	Disagree	Agree	Disagree
1. More real-life skills in science	74	02	92	02
2. More gender issues in science	46	30	40	51
3. More environmental issues	68	09	82	12
4. Science for community development	61	14	69	25
5. More attention to language issues	40	37	43	49

Suggestions for improvement	Lesotho primary teachers (N=77)		Lesotho high school science teachers (N=94)	
	Agree	Disagree	Agree	Disagree
6. More focus on the disadvantaged	67	09	79	13
7. More competitions in science	74	02	92	01
8. More self-discovery in science	72	04	89	04
9. Core plus options in curriculum	55	20	73	19
10. More primary school science	66	09	84	09
11. Wider community consultations	68	06	79	12
12. Computer-aided instruction	66	09	73	20
13. Promoting careers in science	65	10	91	03
14. Excitement and adventure	69	05	90	03
15. Acquiring more resources	77	00	89	03
16. Conducting science campaigns	76	01	91	01
17. More extramural science activities	76	01	93	01
18. External support and recognition	74	03	81	09
19. Better teaching methods	76	01	92	02
20. Science as an entry requirement	46	29	59	32

Table 3

Congruence between the policy preferences of samples of 77 Sotho-speaking primary teachers and 94 high school science teachers in Lesotho in 1999

Suggestions for improvement	Lesotho primary school science teachers (N=77)		Lesotho high school science teachers (N=94)	
	best	least	best	least
1. More real-life skills in science	10	03	18	00
2. More gender issues in science	02	17	01	37
3. More environmental issues	09	11	09	08
4. Science for community development	05	16	03	16
5. More attention to language issues	02	08	08	25
6. More focus on the disadvantaged	02	01	05	11
7. More competitions in science	09	08	10	03
8. More self-discovery in science	10	01	16	03
9. Core plus options in curriculum	04	04	04	08
10. More primary school science	08	07	15	06
11. Wider community consultations	03	13	02	05
12. Computer-aided instruction	05	05	07	13

13. Promoting careers in science	03	03	05	02
14. Excitement and adventure	02	02	03	03
15. Acquiring more resources	27	04	32	04
16. Conducting science campaigns	08	01	04	03
17. More extramural science activities	08	04	10	03
18. External support and recognition	05	03	03	09
19. Better teaching methods	12	06	22	02
20. Science as an entry requirement	04	11	03	20

The initial main findings may be summarised as follows:

1. The respondent science teachers consistently highly prioritised (1) *introducing more real-life skills into the curriculum* for science education qualification, training and upgrading – such as technical, trade, industrial, commercial, manufacturing, marketing and technology skills; (2) *more student self-discovery* in science curricula; and (3) *more science at the primary school level.*
2. In South Africa, but *not* in Lesotho, *rural* science teacher groups gave higher priorities than did *urban* science teacher groups to the importance of (1) *computer-aided instruction* in new science curricula; and (2) focusing on needs and qualifications appropriate for *empowering disadvantaged communities* to address their local problems resourcefully.
3. *Urban* South African science teacher groups gave higher priorities than *rural* South African and Lesotho science teacher groups to the importance of (1) *environmental issues* in qualifications and curricula: and (2) paying more attention to *language.*
4. All groups of responding science teachers strongly *rejected* the suggestion that more *gender-related issues* should be incorporated into new science curricula and qualifications programmes.
5. In Lesotho in 1999, the main focus consensus recommendations from the 171 experienced primary and science teachers' responses to the expanded list of twent· literature-derived suggestions were as follows: The four priority *best ways* to improve school science in Lesotho in the year 2000 are: (1) to acquire *more resources* for schools, such as library books, laboratories and science equipment (59 votes); (2) to *improve teaching methods* (34 votes); (3) to introduce *more real-life skills* into teaching science (28 votes) and (4) to make more use of student *self-discovery* (26 votes).

   The important issue of *"more learner support"* in science lessons was first identified as a special need by 47 Xhosa science students who were surveyed in Cape Town in September 1997, so this item was incorporated into the survey conducted in Lesotho in 1999.
6. In South Africa, during 1996–1998, the main focus consensus recommendations from the 368 science teachers' responses to the 14 literature-derived suggestions were as follows: The three *best ways* to improve science education are: (1) to introduce *more real-life skills* into science teaching (131 votes); (2) to give much more basic science in *primary* schools (128 votes); and (3) to make more use of *self-discovery* by science students (120 votes).

Qualitative findings

A summary of reasons given by the surveyed teachers in 1996 and 1997, in the open-ended section of the questionnaire, for their choices of best or least important items, is as follows:

Introducing more real-life skills into science (item 1)

The following were six recurring comments given by 65 respondents who were in favour of item 1:

- The introduction of real-life skills prepares students for life after school by giving them real-life experiences.
- Teaching using real-life skills is more relevant and real, and will therefore make science more interesting.
- Science teaching and learning using real-life skills will assist in future employment for those students who cannot proceed to tertiary level.

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- Introducing more real-life skills in science will encourage early career choices.
- Teaching science in this manner will make scientific ideas easier to understand and remember. The introduction of more real-life skills into science will be the best way of teaching and learning science as it encourages students and teachers to do more practical work.

Paying more attention to gender issues (item 2)

Seventy respondents rejected item 2, all expressing the view that gender is not an issue in science. The main reason given was that in South Africa there is no discrimination between men and women as scientists, and to emphasise this recommendation for improving the teaching and learning of science curriculum is a waste of time.

Paying more attention to language issues in science (item 5)

The following three reasons were commonly given by 60 respondents who commented against item 5:

- Concentrating more on this recommendation will not make us more competitive internationally.
- Mother-tongue teaching in science will introduce its own additional particular problems of terminology and literature.
- English is already recommended as a standard language of communication in science, both nationally and internationally.

However, three respondents who supported item 5 emphasised the opposite opinion that mother-tongue teaching *would* improve understanding of science in pupils.

Encouraging competitions in science (item 7)

The following were the common reasons given by 40 respondents who supported item 7:

- Competitions create interest and enthusiasm to learn science.
- They encourage students to be their best.
- They stimulate students to work harder.
- They can raise and improve standards.
- Competitions can be fun.
- They encourage scientific creativity.

No qualitative comments were offered as reasons for opposing item 7.

Making more use of self-teaching (item 8)

The following were seven reasons frequently given by 56 respondents who commented in favour of item 8:

- These learning methods cultivate an interest in and understanding of science.
- For many pupils, the best learning is through experience.
- Self-discovery and self-teaching encourage critical thinking.
- Self-discovery and self-teaching motivate the pupils and are therefore very valuable methods for improving the teaching and learning of science and terminology curriculum.
- These teaching methods have the capability to develop problem-solving skills and creative thinking.
- Skills gained through self-teaching can be applied in future careers.
- Self-discovery and self-teaching help students to realise their talents.

Four respondents who opposed item 8, however, expressed a concern that students do not always have the necessary knowledge to teach themselves.

Changing curricula to a compulsory basic syllabus plus options (item 9)

Eleven respondents were in favour of item 9, and all expressed the following view:

- Studying an aspect of science in which one has an interest will increase motivation.

Eight respondents who opposed item 9 gave the following common reason:

- Some people are not interested in science and therefore it cannot be made compulsory.

Giving pupils in the primary schools in South Africa much more science and technology (item 10)

The following is a summary of the comments made by 24 respondents who supported item 10:

- If this recommendation is implemented, pupils in the primary school will receive the necessary applied knowledge of science, and this will arouse their interest.

The four respondents who opposed item 10, however, expressed the following concern:

- More overcrowding of the primary school syllabi would be the result.

Using computer-aided instruction and computer interfacing as part of science experiments (item 12)

The following is a summary of the three reasons given by 26 respondents who commented in favour of item 12:

- This teaching method will make science fun, enjoyable and easy to understand.
- Computer-aided instruction will encourage learning.
- Computer-aided instruction will make teaching and learning easier and interesting.

The following is a summary of the reasons given by seven respondents who wrote against item 12:

- Computers are expensive – there are other needs that are more pressing than computers.

Promoting careers in science and technology among school pupils (item 13)

The following is a summary of the reasons given by nine respondents who supported item 13:

- Career education is important in science because it prepares students for their future.

Sharing and increasing the intellectual excitement and sense of adventure, which science offers (item 14)

The following is a summary of the two reasons given by 13 respondents who commented in favour of item 14:

- Students gain more knowledge by sharing ideas.
- Exciting experimental ideas will encourage more students to pursue science careers.

Other suggestions and recommendations offered by 143 respondents in 1996 and 1997 were:

Resources

The following is a summary of the other written recommendations made by 69 respondents:

- The government should make funding available for:
  - (a) Physical resources, especially building laboratories and libraries.
  - (b) Educational resources, especially buying science equipment and constantly servicing it thereafter, buying textbooks, computers and equipping libraries.

Science campaigns

Eleven respondents also made the following recommendations:

- There should be more campaigns on science and technology to try to make more people aware of its benefits and how it can enrich their lives.
- Also, more bursaries and scholarships should be offered to attract more students in these fields.

Learner support

The following summarises a common recommendation made by 28 respondents:

- There should be more excursions, field trips and visits to universities' science departments, industries, environmental sites and any other places of interest to do more practical work.

Teacher support

Thirty-five teachers recommended that there should be more teacher support in the form of:

- Additional in-service courses
- Teacher upgrading programmes
- More science centres
- More science seminars
- More frequent science workshops.

1999 findings

A brief summary of the reasons given by the surveyed teachers in Lesotho in 1999, in the open-ended section of the questionnaire, for their choices of best or least important items 15 to 20, is as follows:

Acquiring more resources for schools in Lesotho (item 15)

The following sample reasons were given by 59 science teachers who were in favour of item 15:

- Pupils learn better if they see things and are actively involved in practical work.
- It is useless to learn complicated concepts by just appreciating them in class but not seeing them in their immediate environment.
- Bringing resources to the students motivates learning and encourages independent learning.
- Enough equipment enables teachers to impart the information well at a higher level.

Conducting science campaigns (item 16)

The following are sample comments given by 12 science teachers to item 16:

- Pupils will see that science is very important in their lives.
- Offering scholarships and bursaries will make students compete and, as a result, they will begin to like science and work hard.

Having more extramural science activities (item 17)

The following are sample reasons given by 18 science teachers who supported item 17:

- Excursions give students first-hand information, and they experience real objects.

Having external support and recognition for science students (item 18)

Some of the eight science teachers who chose item 18 gave the following reasons for being in favour of item 18:

- Putting up monetary awards will make students work harder.
- If pupils are encouraged by parents, they will try their best to please parents.

Some of the 12 science teachers who were against item 18 felt that most parents are not aware of the benefits of science, so it won't be easy for them to encourage their children to study science.

Having better teaching methods (item 19)

Many of the 34 science teachers who were in favour of item 19 had strong feelings that:

- This might improve attitudes towards science.
- Better teaching methods will make science interesting.
- Better teaching methods will encourage pupils' participation (more especially a child-centred approach).
- Appropriate teaching methods will equip pupils with skills and make them study science even after leaving school.
- One can cope even if the equipment is lacking.

Encouraging future prospects in science (item 20)

The following are sample comments given by some of the 31 science teachers who were against item 20:

- Science is not the only subject to determine individuals' futures.
- Other subjects will be undermined if science is made an entry requirement.
- If a student has a negative attitude towards science, then is forced to do it, that student might end up leaving school altogether.

Some of the seven science teachers who were in favour of item 20 expressed the view that making science an entry requirement would make students work harder.

Other suggestions offered by the Lesotho science teachers in 1999 were:

- Science should be made compulsory at O-level.
- Primary teachers should specialise.
- Career guidance should be done right from primary level.
- Visits to scientific institutions should increase.
- Entry requirements to the higher classes or institutions should be revisited, as some requirements hinder those students who perform excellently in science from proceeding.
- Teachers' salaries must be rewarding.
- High school teachers should be taught science methodology thoroughly.
- Companies and all other interested groups in Lesotho should participate in designing science syllabi.
- Science teaching should be integrated so as to concentrate not only on the Lesotho environment, but also on the world as a whole.
- The examination board and science panel should meet and design a different way of assessing science students.

Statement of the Problem

DISCUSSION

Science has been identified as a major tool in the development of any nation. Therefore, for a nation to develop, it needs to improve its scientific capabilities, and the curriculum and qualifications of its science teachers. Though science has been taught in Lesotho high schools, standards have been deteriorating (Talukdar 1996) and minimal improvements have been done to uplift the standards. It is with this view in mind that this work has been proposed to produce substantial data which clearly prioritises ways and means of improving science teachers' qualifications and science education both in South Africa and in Lesotho in the year 2000, as recommended by science teachers and lecturers, especially when there is strong empirical evidence of consensus among South African and Lesotho science teachers as well.

Many nations today, both developed and developing, are expanding their scientific bases by introducing into their science curricula areas of regional importance or priority like environmental pollution and control, water and power reticulation systems, manufacturing industries, and many other issues. It would therefore be reasonable to improve the teaching of science in the high schools of both Lesotho and South Africa so that the country can have future scientists well equipped to meet the demands of both of these nations. It is also necessary to keep on readjusting teaching and learning methods so as to keep up with those of the rest of the world. For example, in our modern era, computer techniques are basic scientific tools for analysis, leading to the adoption of computer studies in high schools in order to give pupils a good scientific foundation, and these are advocated by the NQF, SAQA and Curriculum 2005 in South Africa as well.

CONCLUSION

The empirical findings of this study suggest that a policy for the curriculum design of a professional qualification in science teacher education for Southern Africa for the year 2000 might be appropriately focused on the key issues of: *coping mechanisms* for working effectively in *under-resourced* schools; acquiring and using better science *teaching methods;* applying science to *real-life situations* and skillfully in teacher training programmes; focusing on specialist *primary* science teacher qualifications; and learning how to foster and encourage more *independent learning* by students in schools, universities and colleges of education. These consensus recommendations, now supported by survey data obtained from 539 science teachers themselves, are consistent with many of the current policies advocated by the NQF, SAQA and Curriculum 2005.

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APPENDIX A

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APPENDIX B

Please tick: Female / Male   Student / Teacher

IMPROVING SCIENCE IN HIGH SCHOOLS IN LESOTHO BY THE YEAR 2000

> Circle AGREE or DISAGREE for each item.
> Key: [A] = AGREE
> [D] = DISAGREE

I think that the teaching and learning of science in Lesotho schools can be improved by:

	CIRCLE	
1. INTROOUCING MORE REAL LIFE INTO SCIENCE (e.g. technical, trade, industrial, commercial, manufacturing and marketing skills for Lesotho.)	[A]	[D]
2. PAYING MORE ATTENTION TO GENOER ISSUES (men and women in science, topics for both boys' and girls' interests; solutions to gender problems, etc.)	[A]	[D]
3. CONCENTRATING MORE ON LESOTHO ENVIRONMENTAL ISSUES (e.g. problems of soil loss and possible solutions, health care, sanitation, air pollution, electricity supply, conservation of plants and animal species, etc.)	[A]	[D]
4. USING SCIENCE TO AOVANCE AND DEVELOP THE LESOTHO COMMUNITY SOCIALLY ANO ECONOMICALLY (i.e. to help solve political, labour, citizenship, social and ethical problems in Lesotho society.)	[A]	[D]
5. PAYING MORE ATTENTION TO LANGUAGE ISSUES (such as technical terms; using mother-tongue (Sesotho) to give instruction; cultural meanings of scientific words; learning to understand terms and language; scientific English as a second language, etc.)		
6. HAVING THE UNDERPRIVILEGEO MAJORITY AS ITS FOCAL POINT (using science education to empower Lesotho communities to address their local problems resourcefully.)	[A]	[D]
7. ENCOURAGING MORE COMPETITIONS IN SCIENCE (with more enterprises to be organised between schools in Lesotho and within schools, such as science quizzes.)	[A]	[D]
8. MAKING MORE USE OF SELF DISCOVERY AND SELF TEACHING (i.e. students designing their own experiments and field work, and developing skills of problem solving, creativity, thinking, etc.)	[A]	[D]
9. CHANGING THE SCIENCE CURRICULUM TO A COMPULSORY SYLLABUS CORE PLUS MANY OPTIONS (which students could choose freely and individually for their own personal relevance and pleasure, and making the syllabi more compatible with the needs of tertiary institutions in Lesotho.)	[A]	[D]
10. GIVING ALL PUPILS IN LESOTHO PRIMARY SCHOOLS MUCH MORE BASIC SCIENCE (Giving primary school pupils much more science education than they are learning at present, i.e. before they come to high schools.)	[A]	[D]
11. ALL INTERESTED GROUPS IN THE LESOTHO COMMUNITIES SHOULD BE CONSULTEO (Community consultations should be made on how science can be improved in high schools by the year 2000.)	[A]	[D]
12. USING COMPUTER-AIOEO INSTRUCTION ANO COMPUTER INTERFACING AS PART OF SCIENCE EXPERIMENTS IN LESOTHO (e.g. to collect, display, combine, analyse and plot data.)	[A]	[D]
13. PROMOTING CAREERS ANO JOB PROSPECTS IN SCIENCE AMONG SCHOOL PUPILS IN LESOTHO	[A]	[O]
14. SHARING AND INCREASING THE INTELLECTUAL EXCITEMENT ANO SENSE OF AOVENTURE WHICH SCIENCE OFFERS (its hopes, benefits, optimism, encouragement, spirit and challenge in Lesotho.)	[A]	[D]
15. ACQUIRING MORE RESOURCES FOR SCHOOLS IN LESOTHO (i.e. libraries, library books, laboratories, science equipment, computers, etc.)	[A]	[D]
16. CONOUCTING SCIENCE CAMPAIGNS (i.e. raising people's awareness about benefits of science for Lesotho and offering more bursaries and scholarships for students to study science.)	[A]	[D]

17. HAVING MORE EXTRAMURAL SCIENCE ACTIVITIES
(in the form of science excursions, fieldwork, more practical work, science clubs, projects, etc.) [A] [D]
18. HAVING EXTERNAL SUPPORT AND RECOGNITION FOR SCIENCE STUDENTS
(encouragement from parents; and putting monetary awards at various levels of science education in Lesotho.) [A] [D]
19. HAVING BETTER TEACHING METHODS
(good science teaching methods are those which promote interest in the study of the physical and natural world and society; and which encourage the practical aspect of the subject.) [A] [D]
20. ENCOURAGING FUTURE PROSPECTS IN SCIENCE
(making science an entry requirement to all science-oriented study at tertiary institutions; and at least one science subject as an entry requirement to non-science tertiary institutions.) [A] [D]

Circle AGREE or DISAGREE for each item.
Key: [A] = AGREE
[B] = DISAGREE

21. Fill in the numbers of four items chosen from the above 20 items:
(a) I THINK THAT THE TWO BEST WAYS OF IMPROVING HIGH SCHOOL SCIENCE IN LESOTHO, OF ALL THOSE MENTIONED ABOVE, ARE NUMBERS: ( ) AND ( ).
(b) I THINK THAT THE TWO LEAST IMPORTANT RECOMMENDATIONS FOR SCIENCE EDUCATION IN LESOTHO MENTIONED ABOVE ARE NUMBERS: ( ) AND ( ).

IN THE SPACES PROVIDED BELOW, YOU ARE ENCOURAGED TO GIVE REASONS FOR SOME OF YOUR ANSWERS; OR YOU MAY BRING UP OTHER SUGGESTIONS WHICH YOU FEEL ARE IMPORTANT FOR IMPROVING SCIENCE EDUCATION IN LESOTHO.

In item 21, my reasons for choosing numbers .... and .... as the two best ways for improving science education in Lesotho are:

....

....

....

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My reasons for choosing numbers .... and .... as the two least important recommendations for improving science education in Lesotho are:

....

....

....

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....

....

What other suggestions can you give for improving science teaching and learning in Lesotho? Please give reasons for your suggestions.

....

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THANK YOU!

JOURNAL OF THE SA ASSOCIATION FOR RESEARCH AND DEVELOPMENT IN HIGHER EDUCATION

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THEMATIC ISSUE

The Reconstruction of Higher and Further Education in South Africa: the Role of the South African Qualifications Authority (SAQA) and the National Qualifications Framework (NQF)

Special Guest Editor
John van der Vyver

CONSULTANT EDITORS

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PURSUIT OF EXCELLENCE

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Science Education for Lesotho Schools in the Year 2000: Concurrence between the Policy Priorities of Science Teachers and Science Students

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ABSTRACT

This study investigates and reports, both qualitatively and quantitatively, the degree of congruence between the science curriculum policy views of 171 science teachers in Lesotho and 368 senior high school science students in Lesotho in the year 1999. The patterns of responses of the science teachers and the science students are found to agree on nine of the twenty policy items presented to them.

PURPOSE

The purpose of this investigation was to investigate, both quantitatively and qualitatively, how closely the curriculum policy views of 171 Lesotho science teachers agreed with those of 368 senior high school students in Lesotho in the year 1999.

BACKGROUND

The study is part of an on-going series of investigations into congruence between the policy preferences of more than 1500 science teachers, lecturers and students during the period 1996 to 1999, as reported in detail in Moru & Rochford (1999) and Rochford et al (1998).

METHODOLOGY

The student response data was collected from ten semi-urban schools during April-May-June in Lesotho using a survey questionnaire containing 20 items with which respondents were invited to agree or disagree. Each of the 20 items was a separate policy statement derived from the science education literature in Lesotho and South Africa.

Each statement was a recommendation for suggesting how the classroom teaching of science might be improved in schools in Southern Africa in the year 2000. Items 1-14 had already been recently developed, standardised and used in ten schools and universities across Southern Africa. Test-re-test reliabilities of the instrument comprising these 14 items were found to vary from r=0.88 to r=0.97, using samples of N=47 and N=14 respondents, over periods ranging from seven days to seven weeks, in 1998. As a sequel to discussion with colleagues in Lesotho in 1998 and 1999, items 15-20 were then added specifically for the Lesotho science teaching context, and the phrasing of items 1-14 was adjusted for Lesotho respondents as well.
One literature-derived recommendation for suggesting how the classroom teaching of science might be improved in schools in Southern Africa read as follows:

> "Learning science through the African indigenous technology and culture, and through the African world view of life and thought systems (i.e. preserving what is good in African culture and tradition, regarding science as sacred, learning science through African theories of space and time, the kinship system, customs, images, symbols, forms of expression, values, feelings and interpretations)..."

However, this item was discarded and subsequently deleted from the survey questionnaire adapted for Lesotho after pilot trials of the literature-derived recommendations found that this item was not favoured by a large proportion of a sample of 749 Tsonga, Setswana, Xhosa, English and Afrikaans respondents who were presented with this suggestion during the period 1996-1997. The cultural and ethnic aspects of science, previously thought to be particularly important, unexpectedly were found to be preferentially recommended and prioritised by only 11 out of 205 Tsonga science teachers surveyed; by only 5 out of 134 Setswana science teachers; by only two out of 44 Xhosa science teachers; by only seven out of 47 Xhosa high school science students surveyed; by only 23 out of 270 English/Afrikaans high school science students; and by none of the 49 English/Afrikaans science teachers and lecturers who took part in the trial surveys conducted during the years 1996-1997 (Sokopo & Rochford, 1999:209).

Hence this item, advocating a role for ethnicity and culture in attempts to improve the teaching and learning of science, was deleted from the survey questionnaire designed for use in 1999, in order to keep the number of items in the data-collection instrument to a maximum of 20 (i.e. two pages long), and to reduce possible fatigue among the 539 respondents in Lesotho.

A copy of the final version of the 20-item data-collection instrument used in Lesotho in 1999 is available from the author.

The respondents surveyed in this study comprised three samples. They were 94 high school science teachers in Lesotho, 77 primary science teachers in Lesotho, and 368 senior high school science pupils in Lesotho, from both rural and urban areas.

In addition to agreeing or disagreeing with the 20 policy statements, all the respondents were asked to choose which TWO of these policy recommendations they considered to be the most important for Lesotho science classes in the year 2000, and which two recommendations they considered to be the least important suggestions.

On the back of the questionnaire the respondents were invited to give their qualitative responses and suggestions, explaining the reasons for their choices.

FINDINGS

1. Quantitative

A preliminary analysis of the data disclosed that the patterns of responses of the science teachers and the science students differed statistically on eleven of the twenty policy items. These are presented in Tables 1 and 2. Whilst there is substantial agreement between both science teachers and science students on the DIRECTIONS of their policy preferences, there are some appreciable differences between the EXTENT of their agreement or disagreement with certain policy recommendations.

Table 1: Concurrence between the policy agreement of samples of 171 Sotho-speaking primary and high school science teachers and 368 Sotho-speaking senior high school science students in Lesotho in 1999.

Suggestions for improvement	Sotho-speaking primary and high school science teachers (N=171)		Sotho-speaking high school students (N=368)			
	% Agree	% Disagree	% Agree	% Disagree	chi-square	p-value
1. More real life skills in science	97	02	83	17	21.92	0.0000 **
2. More gender issues in science	50	47	66	32	11.65	0.0006 **
3. More environmental issues	88	12	82	17	01.69	0.1936
4. Science for community development	76	23	58	40	15.59	0.0001 **
5. More attention to language issues	49	50	40	59	02.90	0.0884
6. More focus on the disadvantaged	85	13	73	24	09.10	0.0026 **
7. More competitions in science	97	02	96	04	01.53	0.2160
8. More self-discovery in science	94	05	80	18	16.23	0.0001 **
9. Core plus options in curriculum	75	23	56	40	15.90	0.0001 **
10. More primary school science	88	11	83	15	01.50	0.2212
11. Wider community consultations	86	11	85	12	00.15	0.6988
12. Computer-aided instruction	81	17	77	20	00.45	0.5033
13. Promoting careers in science	91	08	83	12	02.33	0.1270
14. Excitement and adventure	93	05	78	17	15.05	0.0001 **
15. Acquiring more resources	97	02	95	03	00.51	0.4738
16. Conducting science campaigns	98	01	91	07	07.14	0.0075 **
17. More extramural science activities	99	01	88	09	11.33	0.0008 **
18. External support and recognition	91	07	82	15	05.81	0.0159 *
19. Better teaching methods	98	02	91	07	05.23	0.0222 *
20. Science as an entry requirement	61	36	59	37	00.05	0.8173

** $p<0.01$ Highly significant difference between teachers' and students' response patterns on these items. N.B. Frequencies, not percentages have been used for chi-square calculations.

* $p<0.05$ Significant difference between teachers' and students' response patterns on these items. Items 3, 5, 7, 10, 12, 13, 15, and 20 : The pattern of responses of the science students agrees with the patterns of responses of their science students.

Table 2 : Concurrence between the policy preferences of samples of 77 Sotho-speaking primary science teachers, 94 high school science teachers and 368 Sotho-speaking senior high school science students in Lesotho in 1999.

Suggestions for improvement	Sotho-speaking primary teachers (N=77)		Sotho-speaking high school science teachers (N=94)		Sotho-speaking high school students (N=368)	
	best	Least	best	least	best	least
1. More real life skills in science	10	03	18	00	15	17
2. More gender issues in science	02	17	01	37	04	45
3. More environmental issues	09	05	09	08	19	34
4. Science for community development	05	11	03	16	11	32
5. More attention to language issues	02	16	08	25	08	93
6. More focus on the disadvantaged	02	08	05	11	04	15
7. More competitions in science	09	08	10	03	78	22
8. More self-discovery in science	10	01	16	03	59	19
9. Core plus options in curriculum	04	04	04	08	18	49
10. More primary school science	08	07	15	06	57	50
11. Wider community consultations	03	13	02	05	03	26
12. Computer-aided instruction	05	05	07	13	44	36
13. Promoting careers in science	03	03	05	02	26	21
14. Excitement and adventure	02	02	03	03	09	16
15. Acquiring more resources	27	04	32	04	127	16
16. Conducting science campaigns	08	01	04	03	63	32
17. More extramural science activities	08	04	10	03	36	15
18. External support and recognition	05	03	03	09	14	15
19. Better teaching methods	12	06	22	02	58	26
20. Science as an entry requirement	04	11	03	20	05	44

2. Qualitative

The qualitative findings may be summarised, in part, as follows, as a sequel to those reported earlier in Moru & Rochford (2000, in press):

A brief summary of the reasons given by the surveyed teachers in Lesotho on 1999, in the open-ended section of the questionnaire, for their choices of best or least important items 15 to 20, is as follows:

Acquiring more resources for schools in Lesotho (item 15)

The following sample reasons were given by 59 science teachers who were in favour of item 15:

> "Pupils learn better if they see things and are actively involved in practical work".

> "It is useless to learn complicated concepts by just appreciating them in class but not seeing them in their immediate environment".

> "Bringing resources to the students motivates learning and encourages independent learning".

"Enough equipment enables teachers to impart the information well at a higher level".

Conducting science campaigns (item 16)

The following are sample comments given by 12 science teachers to item 16:

"Pupils will see that science is very important in their lives".
"Offering scholarships and bursaries will make students compete and, as a result, they will begin to like science and work hard".

Having more extramural science activities (item 17)

The following reason was the consensus one offered by 18 science teachers who supported item 17:

"Excursions give students first hand information, and they experience real objects".

Having external support and recognition for science students (item 18)

Some of the eight science teachers who chose item 18 gave the following reasons for being in favour of item 18

"Putting monetary awards will make students work harder".
"If pupils are encouraged by parents, they will try their best to please parents".

Some of the 12 science teachers who opposed item 18 felt that most parents were not aware of the benefits of science, so it would not be easy for them to encourage their children to study science.

Having better teaching methods (item 19)

Many of the 34 science teachers who were in favour of item 19 expressed strong feelings that:

"This might improve attitudes towards science".
"Better teaching methods will make science interesting".
"Better teaching methods will encourage pupils' participation (more especially a child-centred approach)".
"Appropriate teaching methods will equip pupils with skills and make them study science even after leaving school".
"One can cope even if the equipment is lacking".

Encouraging future prospects in science (item 20)

The following are sample comments given by some of the 31 science teachers who rejected item 20:

"Science is not the only subject to determine individuals' futures".
"Other subjects will be undermined if science is made an entry requirement".
"If a student has a negative attitude towards science, then forced to do it, that student might end up leaving school altogether".

However, some of the seven science teachers who favoured item 20 expressed the view that making science an entry requirement would make students work harder.

Other suggestions offered by the Lesotho science teachers in 1999 were that science should be made compulsory at O-level: primary teachers should specialise: career guidance should be done right from primary level: visits to scientific institutions should increase: entry requirements to the higher classes or institutions should be revisited, as some requirements hinder those students who perform excellently in science from proceeding: teachers' salaries must be rewarding: high school teachers should be taught science methodology thoroughly: companies and all other interested groups in Lesotho should participate in designing science syllabi: science teaching should be integrated so as to concentrate not only on the Lesotho environment, but also on to the world as a whole: and the examination board and science panel should meet and design a different way of assessing science students.

DISCUSSION AND CONCLUSION

The most important recommendation which has emerged from both science students and science teachers is that the supply of MORE RESOURCES for schools in Lesotho might be the overwhelming first priority, i.e. more books, laboratories, equipment, etc. are required urgently by the year 2000.

Other favoured recommendations include probably more emphasis on better teaching methods in science lessons, more self-discovery in science, more primary school science, more real life skills in science teaching and more competitions in science in Lesotho. However, in this study only ten high schools were included in the survey, so caution must be exercised in any desire possibly to generalise to Lesotho science students and their teachers as a whole.

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BIENNIAL SAARDHE CONFERENCE

THEME: THE RECONSTRUCTION OF HIGHER EDUCATION IN SOUTH AFRICA AND THE ROLE OF SAQA (SA QUALIFICATIONS AUTHORITY) AND NQF (NATIONAL QUALIFICATIONS FRAMEWORK)

ORGANISERS: SA ASSOCIATION FOR RESEARCH AND DEVELOPMENT IN HIGHER EDUCATION (SAARDHE)

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PENINSULA TECHNIKON

SAQA and NQF policy issues in the design of a new professional curriculum for science teacher education

A Moru & K Rochford
University of Cape Town

During 1995 a review of the science education policy literature disclosed at least fourteen possible recommendations for improving the current qualification programmes and science curricula relevant to science teacher education training, development and up-grading. By 1999 these suggestions had increased in number to twenty. Hence, our most recent findings from Lesotho are also incorporated into the conclusion of this report on a common study which has extended over six regions of Southern Africa.

The investigation surveyed 49 experienced urban science teachers and lecturers in Cape Town and Johannesburg; 205 rural science teachers-in-training (home language Xitsonga) at a college of education in the Northern Province; 114 experienced rural high school science teachers in the North West Province, of whom 96% spoke Setswana as their home language; and 77 experienced primary and 94 experienced secondary science teachers in Lesotho.

The comparative first part of this wide-ranging investigation focussed on five groups' responses to 14 common policy statements during the two-and-a half year survey.

The initial main findings were as follows:-

1. The respondent science teachers consistently highly prioritised (1) introducing more real life skills into the curriculum for science teacher

education qualifications, training and upgrading - such as technical, trade, industrial, commercial, manufacturing, marketing and technology skills; (2) more student self-discovery in science curricula; and (3) more science at the primary school level.

2. In South Africa, but NOT in Lesotho, rural science teacher groups have higher priorities than urban science teacher groups to the importance of (1) computer-aided instruction in new science curricula; and (2) focussing on needs and qualifications appropriate for empowering disadvantaged communities to address their local problems resourcefully.
3. Urban South African science teacher groups have higher priorities than rural South African and Lesotho science teacher groups to the importance of (1) environmental issues in qualifications and curricula; and (2) paying more attention to language.
4. All groups of responding science teachers strongly rejected the suggestion that more gender-related issues should be incorporated into new science curricula and qualifications programmes.

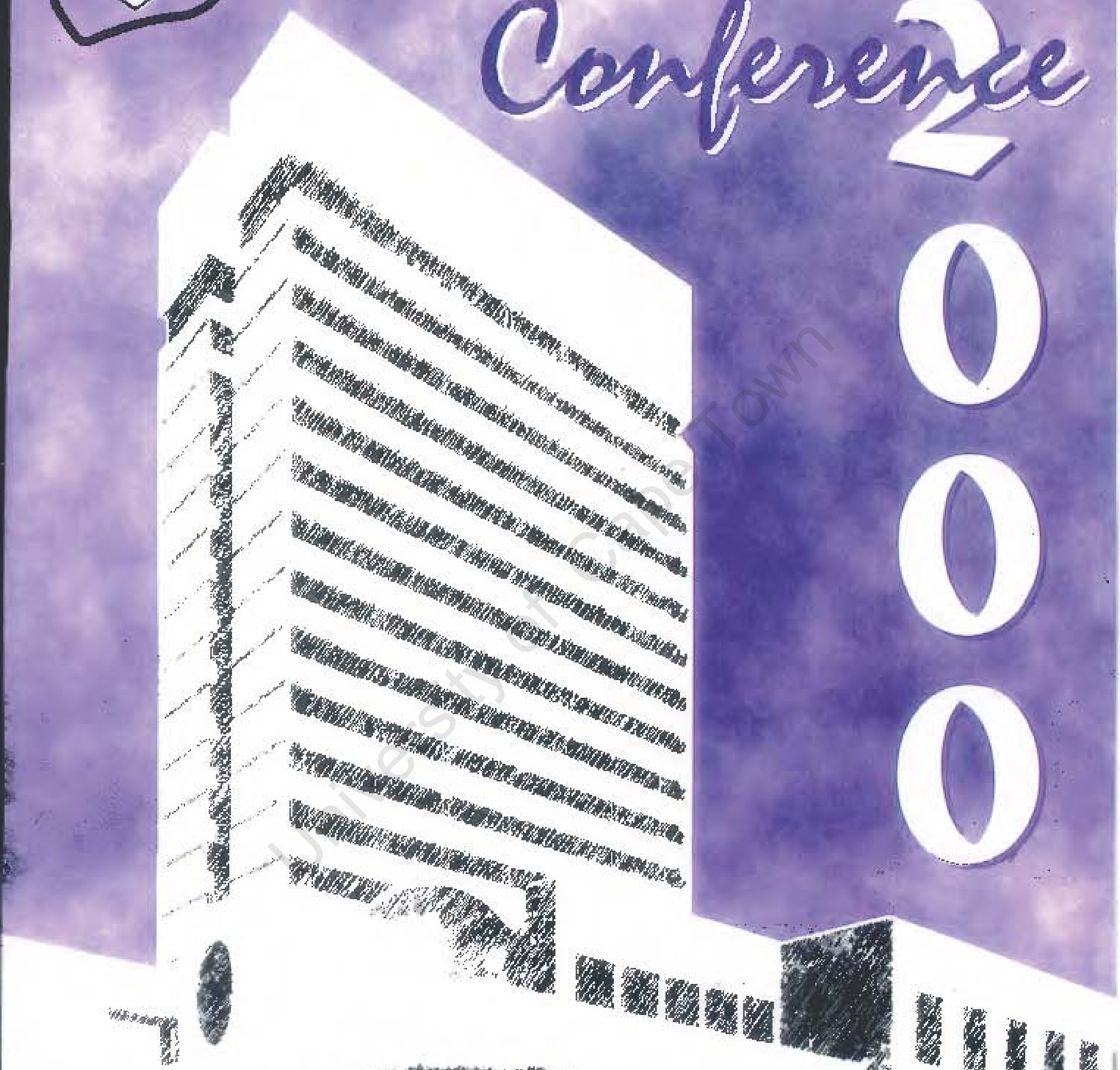
The second phase of this study was conducted in Lesotho in 1999. The main consensus recommendations from the 171 experienced primary and science teachers' responses to an expanded list of twenty literature-derived suggestions were as follows:-

The best ways to improve school science in Lesotho in the year 2000 are: (1) to acquire more resources for schools, such as library books, laboratories and science equipment (59 votes); (2) to improve teaching methods (34 votes); (3) to introduce more real life skills into teaching science (28 votes); and (4) to make more use of self-discovery (26 votes).

The important issue of "more learner support" in science lessons was first identified as a special need by 47 Xhosa science students who were surveyed in Cape Town in September 1997, so this item was incorporated into the survey conducted in Lesotho in 1999. The findings of this study suggest that a policy for the curriculum design of a professional qualification in science teacher education for Southern Africa for the year 2000 might be appropriately focussed on the key issues of: coping mechanisms for working effectively in under-resourced schools; acquiring and using better science teaching methods; applying science to real life situations and skills in teacher training programmes; and learning how to foser and encourage more independent learning by pupils in schools.

Southern African Association for Research in Mathematics & Science Education

Conference 2000



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UPE

CONGRUENCE BETWEEN THE POLICY PRIORITIES OF SCIENCE TEACHERS AND SCIENCE STUDENTS IN LESOTHO FOR THE YEAR 2000

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ABSTRACT

This study investigates and reports, both qualitatively and quantitatively, the degree of concurrence between the science curriculum policy views of 171 science teachers in Lesotho and 368 senior high school science students in Lesotho in the year 1999. The patterns of responses of the science teachers and the science students were found to agree on nine of the twenty policy items presented to them.

PURPOSE

The purpose of this investigation was to investigate, both quantitatively and qualitatively, how closely the curriculum policy views of 171 Lesotho science teachers agreed with those of 368 senior high school students in Lesotho in the year 1999.

BACKGROUND

The study is part of an on-going series of investigations into congruence between the policy preferences of more than 1500 science teachers, lecturers and students during the period 1996 to 1999, as reported in detail in Moru & Rochford (1999) and Rochford et al (1998).

METHODOLOGY

The data was collected in April-May-June in Lesotho using a survey questionnaire containing 20 items with which respondents were invited to agree or disagree. Each of the 20 items was a separate policy statement derived from the science education literature in Lesotho and South Africa.

Each statement was a recommendation for suggesting how the classroom teaching of science might be improved in schools in Southern Africa in the year 2000. Items 1-14 had already been recently developed, standardised and used in ten schools and universities across Southern Africa. Test-re-test reliabilities of the instrument comprising these 14 items were found to vary from $r=0.88$ to $r=0.97$, using samples of $N=47$ and $N=14$ respondents, over periods ranging from seven days to seven weeks, in 1998. As a sequel to discussion with colleagues in Lesotho in 1998 and 1999, items 15-20 were then added specifically for the Lesotho science teaching context, and the phrasing of items 1-14 was adjusted for Lesotho respondents as well.

A copy of the first two pages of the final version of the 20-item data-collection instrument used in Lesotho in 1999 is appended.

The respondents surveyed in this study comprised three samples. They were 94 high school science teachers in Lesotho, 77 primary science teachers in Lesotho, and 368 senior high school science pupils in Lesotho, from both rural and urban areas.

In addition to agreeing or disagreeing with the 20 policy statements, all the respondents were asked to choose which TWO of these policy recommendations they considered to be the most important for Lesotho science classes in the year 2000, and which two recommendations they considered to be the least important suggestions.

On the back of the questionnaire the respondents were invited to give their qualitative responses and suggestions, explaining the reasons for their choices.

FINDINGS

A preliminary analysis of the data disclosed that the patterns of responses of the science teachers and the science students differed statistically on eleven of the twenty policy items. Two tables of results are attached. Whilst there is substantial agreement between both science teachers and science students on the DIRECTIONS of their policy preferences, there are some appreciable differences between the EXTENT of their agreement or disagreement with certain policy recommendations.

The qualitative findings may be summarised, in part, as follows:

Fifty nine science teachers wrote full reasons in support of the need to acquire more resources for schools in Lesotho. The importance of conducting science campaigns was explained by twelve teachers, and eighteen science teachers gave explanations for the favouring of more extramural science activities. Eight teachers described why they wanted Lesotho science students to have more external support and recognition; and thirty four teachers wrote strongly about the importance of adopting better teaching methods. Finally, thirty one teachers offered reasons for opposing the entry-requirement policy recommendation offered in item 20, but seven teachers wrote reasons in favour of making science an obligatory entry requirement for studying tertiary-level science.

Table 1: Congruence between the policy agreement of samples of 171 Sotho-speaking primary and high school science teachers and 368 Sotho-speaking senior high school science students in Lesotho in 1999.

Suggestions for improvement	Sotho-speaking primary and high school science teachers (N=171)		Sotho-speaking high school students (N=368)			
	Agree	Disagree	Agree	Disagree	chi-square	p-value
1. More real life skills in science	166	04	305	63	21.92	0.0000 **
2. More gender issues in science	086	81	244	118	11.65	0.0006 **
3. More environmental issues	150	21	301	062	01.69	0.1936
4. Science for community development	130	39	212	148	15.59	0.0001 **
5. More attention to language issues	083	86	149	216	02.90	0.0884
6. More focus on the disadvantaged	146	22	269	090	09.10	0.0026 **
7. More competitions in science	166	03	354	016	01.53	0.2160
8. More self-discovery in science	161	08	293	065	16.23	0.0001 **
9. Core plus options in curriculum	128	39	205	147	15.90	0.0001 **
10. More primary school science	150	18	304	054	01.50	0.2212
11. Wider community consultations	147	18	314	045	00.15	0.6988
12. Computer-aided instruction	139	29	285	072	00.45	0.5033
13. Promoting careers in science	156	13	305	044	02.33	0.1270
14. Excitement and adventure	159	08	288	062	15.05	0.0001 **
15. Acquiring more resources	166	03	350	012	00.51	0.4738
16. Conducting science campaigns	167	02	336	026	07.14	0.0075 **
17. More extramural science activities	169	02	325	034	11.33	0.0008 **
18. External support and recognition	155	12	303	054	05.81	0.0159 *
19. Better teaching methods	168	03	336	025	05.23	0.0222 *
20. Science as an entry requirement	105	61	218	135	00.05	0.8173

** $p<0.01$ Highly significant difference between teachers' and students' response patterns on these items.
* $p<0.05$ Significant difference between teachers' and students' response patterns on these items.
Items 3, 5, 7, 10, 12, 13, 15, and 20 : The pattern of responses of the science students agrees with the patterns of responses of their science ~~students.~~ teachers .

Table 2 : Congruence between the policy preferences of samples of 77 Sotho-speaking primary science teachers, 94 high school science teachers and 368 Sotho-speaking senior high school science students in Lesotho in 1999.

Suggestions for improvement	Sotho-speaking primary teachers (N=77)		High school science teachers (N=94)		Sotho-speaking high school students (N=368)	
	best	least	best	least	best	least
1. More real life skills in science	10	03	18	00	15	17
2. More gender issues in science	02	17	01	37	04	45
3. More environmental issues	09	05	09	08	19	34
4. Science for community development	05	11	03	16	11	32
5. More attention to language issues	02	16	08	25	08	93
6. More focus on the disadvantaged	02	08	05	11	04	15
7. More competitions in science	09	08	10	03	78	22
8. More self-discovery in science	10	01	16	03	59	19
9. Core plus options in curriculum	04	04	04	08	18	49
10. More primary school science	08	07	15	06	57	50
11. Wider community consultations	03	13	02	05	03	26
12. Computer-aided instruction	05	05	07	13	44	36
13. Promoting careers in science	03	03	05	02	26	21
14. Excitement and adventure	02	02	03	03	09	16
15. Acquiring more resources	27	04	32	04	127	16
16. Conducting science campaigns	08	01	04	03	63	32
17. More extramural science activities	08	04	10	03	36	15
18. External support and recognition	05	03	03	09	14	15
19. Better teaching methods	12	06	22	02	58	26
20. Science as an entry requirement	04	11	03	20	05	44

DISCUSSION AND CONCLUSION

The most important recommmendation which has emerged from both science students and science teachers is that the supply of MORE RESOURCES for schools in Lesotho is the overwhelming first priority, i.e. more books, laboratories, equipment, etc. are required urgently by the year 2000.

ACKNOWLEDGEMENTS

The writers acknowledge, with thanks, the generous financial assistance of the University Research Grants Committee of the University of Cape Town to the dissemination of this research, and the National Manpower Development Secretariat of Lesotho; and the assistance of all the teachers in the schools who developed or completed the questionnaires in Lesotho and South Africa.

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Please tick: Female / Male — Student / Teacher

IMPROVING SCIENCE IN HIGH SCHOOLS IN LESOTHO BY THE YEAR 2000.

Circle AGREE or DISAGREE for each item.
Key: [A] = AGREE
[D] = DISAGREE

I think that the teaching and learning of science in Lesotho schools can be improved by:-

	CIRCLE	
1. INTRODUCING MORE REAL LIFE SKILLS INTO SCIENCE (e.g. technical, trade, industrial, commercial, manufacturing and marketing skills for Lesotho.)	[A]	[D]
2. PAYING MORE ATTENTION TO GENDER ISSUES (men and women in science, topics for both boys' and girls' interests; solutions to gender problems, etc.)	[A]	[D]
3. CONCENTRATING MORE ON LESOTHO ENVIRONMENTAL ISSUES (e.g. problems of soil loss and possible solutions, health care, sanitation, air pollution, electricity supply, conservation of plants and animal species, etc.)	[A]	[D]
4. USING SCIENCE TO ADVANCE AND DEVELOP THE LESOTHO COMMUNITY SOCIALLY AND ECONOMICALLY (i.e. to help solve political, labour, citizenship, social and ethical problems in Lesotho society.)	[A]	[D]
5. PAYING MORE ATTENTION TO LANGUAGE ISSUES (such as technical terms; using the mother tongue (Sesotho) to give instruction; cultural meanings of scientific words; learning to understand terms and language; scientific English as a second language, etc.)	[A]	[D]
6. HAVING THE UNDERPRIVILEGED MAJORITY AS ITS FOCAL POINT (Using science education to empower Lesotho communities to address their local problems resourcefully.)	[A]	[D]
7. ENCOURAGING MORE COMPETITIONS IN SCIENCE (with more enterprises to be organised between schools in Lesotho and within schools, such as science quizzes.)	[A]	[D]
8. MAKING MORE USE OF SELF-DISCOVERY AND SELF-TEACHING (i.e. students designing more of their own experiments and field work, and developing skills of problem solving, creativity, thinking, etc.)	[A]	[D]
9. CHANGING THE SCIENCE CURRICULUM TO A COMPULSORY CORE SYLLABUS PLUS MANY OPTIONS (which students could choose freely and individually for their own personal relevance and pleasure, and making the syllabi more compatible with the needs of tertiary institutions in Lesotho.)	[A]	[D]

10. GIVING ALL PUPILS IN LESOTHO PRIMARY SCHOOLS MUCH MORE BASIC SCIENCE
(Giving primary school pupils much more science education than they are learning at present, i.e. before they come to high schools.) [A] [D]

11. ALL INTERESTED GROUPS IN THE LESOTHO COMMUNITIES SHOULD BE CONSULTED
(Community consultations should be made on how science can be improved in high schools by the year 2000.) [A] [D]

12. USING COMPUTER-AIDED INSTRUCTION AND COMPUTER INTERFACING AS PART OF SCIENCE EXPERIMENTS IN LESOTHO
(e.g. to collect, display, combine, analyse and plot data.) [A] [D]

13. PROMOTING CAREERS AND JOB PROSPECTS IN SCIENCE AMONG SCHOOL PUPILS IN LESOTHO [A] [D]

14. SHARING AND INCREASING THE INTELLECTUAL EXCITEMENT AND SENSE OF ADVENTURE WHICH SCIENCE OFFERS
(its hopes, benefits, optimism, encouragement, spirit and challenge in Lesotho.) [A] [D]

15. ACQUIRING MORE RESOURCES FOR SCHOOLS IN LESOTHO
(i.e. libraries, library books, laboratories, science equipment, computers, etc.) [A] [D]

16. CONDUCTING SCIENCE CAMPAIGNS
(i.e. raising people's awareness about benefits of science for Lesotho and offering more bursaries and scholarships for students to study science.) [A] [D]

17. HAVING MORE EXTRAMURAL SCIENCE ACTIVITIES
(in the form of science excursions, fieldwork, more practical work, science clubs, projects, etc.) [A] [D]

18. HAVING EXTERNAL SUPPORT AND RECOGNITION FOR SCIENCE STUDENTS
(encouragement from parents; and putting monetary awards at various levels of science education in Lesotho.) [A] [D]

19. HAVING BETTER TEACHING METHODS
(good science teaching methods are those which promote interest in the study of the physical and natural world and society; and which encourage the practical aspect of the subject.) [A] [D]

20. ENCOURAGING FUTURE PROSPECTS IN SCIENCE
(making science an entry requirement to all science-oriented study at tertiary institutions; and at least one science subject as an entry requirement to non-science tertiary institutions.) [A] [D]

Circle AGREE or DISAGREE for each item.
Key: [A]= AGREE
[D]= DISAGREE

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UNESCO International Centre for Engineering Education (UICEE)

2nd

GLOBAL CONGRESS ON ENGINEERING EDUCATION

in collaboration with

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University of Technology, Business and Design
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Teachers' and students' common recommendations for science and technology curriculum advancement in Lesotho

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ABSTRACT: This quantitative and qualitative study in Southern Africa investigates and reports the occurrence of common areas of agreement among the choices of science and technology curriculum policy options selected by 171 science/technology teachers and 368 senior high school science/technology students who were surveyed in the Kingdom of Lesotho during 1999. The response profiles of the teachers were found to match those of their students on nine of the twenty science and technology curriculum policy possibilities and literature-derived recommendations offered to them as alternative choices relevant to the current needs, issues and debates in Lesotho education.

INTRODUCTION AND PURPOSE

The purpose of this investigation was to investigate, both quantitatively and qualitatively, how closely the curriculum policy views of 171 Lesotho science/technology teachers agreed with those of 368 senior high school science/technology students in the year 1999.

In addition to agreeing or disagreeing with twenty basic policy statements presented to them, all 539 respondents were invited to select, with reasons, *two* policy recommendations which they considered to be the *most* important ways to advance science/technology classes in the year 2000, and which *two* recommendations they considered to be the *least* important as priority improvements.

One special focus of this study was the on-going debate in Lesotho as to whether or not science should be an entry requirement for future study at a Lesotho technikon or at a Faculty of Engineering in a neighbouring region of Southern Africa.

BACKGROUND

The study is part of an on-going series of debates and investigations into concurrences between the S-E-T policy preferences of more than 1500 engineering and technology lecturers, science and technology teachers, science education academics and science/technology students during the period 1996 to 1999.

This has been reported in detail in Moru & Rochford (2000, in press), Sokopo & Rochford (1999), and Rochford et al. (1997), in order to provide a clearer focus for needed improvements in S-E-T education in developing areas of Southern Africa [1-3].

METHODOLOGY

The response data from teachers and students was collected from ten semi-urban schools in Lesotho during April-May-June 1999. The survey questionnaire contained 20 items with which all respondents were invited to agree or disagree. Each of the 20 response items consisted of a separate policy statement derived and amplified from the recent and current science/technology education literature in Lesotho and Southern Africa.

Each statement was a broad recommendation, with supporting illustrative examples and details, suggesting how the classroom teaching of science/technology might be improved in schools in Southern Africa in the year 2000. Items 1 to 14 had been recently developed, standardised and used in eleven schools and universities across Southern Africa. Test/re-test reliabilities of the instrument comprising these 14 items were found to vary from $r = 0.88$ to $r = 0.97$, over periods ranging from seven days to seven weeks, using samples of N=47 and N=14 respondents, during 1998.

The content validity and linguistically accurate wording of the policy statements, derived and modified specifically for the Lesotho science/technology teaching context, were established and improved iteratively in a sequence of collaborative discussions, item by item, with science teaching colleagues in both Lesotho and Southern Africa in 1998 and 1999. This was prior to the final distribution of the questionnaire to intact classes of respondents. A 99% response and return rate then resulted under these conditions of mass surveying.

A copy of the final version of the data-collection instrument used in Lesotho in 1999 is available from the authors. Part A (quantitative) consists of 22 items; part B (qualitative) contains two open-ended questions which invited respondents to justify (give reasons for) their most favoured and least favoured preferences in section A, and to offer further comments.

Three different samples were surveyed in this study. They comprised 94 science/technology teachers in Lesotho; 77 primary science teachers in Lesotho; and 368 senior high school science/technology students in ten conveniently available secondary institutions in both rural and urban regions of Lesotho.

In addition to agreeing or disagreeing with the 20 presented statements, all respondents were asked to choose which of these policy recommendations they would select as the *two most important* for Lesotho science/technology classes in the year 2000. They were also asked which recommendations they considered to be the *two least important* suggestions.

Finally, on the reverse side of the questionnaire, the respondents from the ten schools were invited to give their qualitative responses and suggestions, explaining the reasons for their choices.

FINDINGS

Quantitative Results

A preliminary analysis of the data disclosed that the patterns of responses of the science/technology teachers and the science/technology students *differed substantially* on 11 of the 20 policy items. These are presented in Tables 1 and 2. Whilst there is *substantial agreement* between both science/technology teachers and science/technology students on the *directions* of their policy preferences, nevertheless there are some *appreciable differences* between the *extent* of their agreement or disagreement with certain policy recommendations.

The *most important* recommendation singled out by teachers as well as by students of science/technology was that an *increased supply of resources* for classrooms was perceived as the overwhelming first priority, ie: more laboratories, apparatus, books, equipment, manuals, machine demonstrations, etc. were urgently sought for the year 2000.

Other advocated, strongly favoured recommendations included:

- the introduction of better classroom instructional methods;
- the use of more self-discovery in learning;
- the incorporation of more real life skills into science teaching;
- the introduction of more science and technology into the primary school syllabus;
- the organisation of more school competitions in science/technology in Lesotho.

Qualitative Results

As a sequel to qualitative findings reported earlier in Moru & Rochford [1], the qualitative response and suggestion patterns with particular local reference to Lesotho are summarised here.

The following is a brief synopsis of the reasons given by the surveyed teachers in Lesotho in the open-ended section of the questionnaire, for selecting their high priority items numbered 15, 19, 1, 8 and 10 respectively.

Item 15: Acquiring More Resources For Schools In Lesotho

The following are sample reasons given by 59 science/technology teachers who were strongly in favour of item 15:

- *Pupils learn better if they see things and are actively involved in practical work;*
- *It is useless to learn complicated concepts by just appreciating them in class but not seeing them in their immediate environment;*
- *Bringing the resources to students motivates learning and encourages independent learning;*
- *Enough equipment enables teachers to impart the information well at a higher level.*

Item 19: Having Better Teaching Methods

Many of the 34 science/technology teachers who were in favour of item 19 expressed strong feelings that:

- *This might improve attitudes towards science;*
- *Better teaching methods will make science interesting;*
- *Better teaching methods will encourage pupils' participation (more especially a child-centred approach);*
- *Appropriate teaching methods will equip pupils with skills and make them study science even after leaving school;*
- *One can cope even if the equipment is lacking.*

Item 1: Introducing More Real Life Skills Into Science

The following six arguments recurred repeatedly among the 28 teachers who favoured item 1:

- The introduction of real life skills prepares students for life after school by giving them real life experiences.
- Teaching using real life skills is more relevant and real, and will therefore make science more interesting.
- Science teaching and learning using real life skills will assist in future employment for those students who cannot proceed to tertiary level.
- Introducing more real life skills in science will encourage early career choices.
- Teaching science in this manner will make scientific ideas easier to understand and remember.
- The introduction of more real life skills into science will be the best way of teaching and learning science as it encourages students and teachers to do more practical work.

Item 8: Making More Use Of Self-Teaching

The following seven reasons were frequently given by 26 teachers who commented in favour of item 8:

- These learning methods cultivate an interest in and understanding of science.
- For many students, the best learning is through experience.
- Self-discovery and self-teaching encourage critical thinking.
- Self-discovery and self-teaching motivate the students, and are therefore very valuable methods for improving the

teaching and learning of a science and technology curriculum.

- These teaching methods have the capacity to develop problem-solving skills and creative thinking.
- Skills gained through self-teaching can be applied in future careers.
- Self-discovery and self-teaching help students to realise their talents.

Item 10: Giving Pupils In The Primary Schools In Lesotho Much More Science And Technology

The following is a summary of the comments made by 23 teachers who supported item 10:

> *If this recommendation is implemented, pupils in the primary school will receive the necessary applied knowledge of science, and this will arouse their interest.*

The suggestion that *a science entry requirement be imposed on aspirant Lesotho technologists*, engineers, scientists, etc. wishing to proceed to tertiary studies was *opposed* with written reasons by at least 31 teachers. However, seven teachers took the *opposite* view, writing reasons for making science an *obligatory* entry requirement for future study at a Lesotho technikon or at a Faculty of Engineering in a neighbouring country such as Botswana or South Africa.

Other suggestions offered by the Lesotho science teachers in 1999 were that:

- Science should be made compulsory at O-level;
- Primary teachers should specialise;
- Career guidance should feature right from primary level;
- Visits to scientific institutions should increase;
- Entry requirements to higher classes or institutions should be revisited, since some requirements hinder those students who perform very well in science from proceeding;
- Teachers salaries must be rewarding;
- High school teachers should be taught science/technology methodology thoroughly;
- Companies and other interested groups in Lesotho should participate in designing science syllabi;
- Science teaching should be integrated so as to concentrate not only on the Lesotho environment, but also on the world as a whole;
- The examination board and science panel should meet and design a different way of assessing students.

DISCUSSION AND CONCLUSION

The most important recommendation which has emerged from both science /technology teachers students and science students is that the provision of *more resources* for schools in Lesotho might be the overwhelming first priority. However, one cannot generalise on the basis of the responses obtained from only ten conveniently accessible schools. The greater need appears to be for more books, laboratories, equipment, etc. by the year 2000.

Other favoured recommendations include: probably a greater emphasis on better teaching methods in lessons on technology and science; more self-discovery in science and in technology projects; more primary school science and technology; more real life skills in science teaching; and introducing more competitions in science in Lesotho.

These findings suggest how tertiary lecturers in engineering and technical education might focus more effectively their efforts to influence and encourage the technical development of aspirant young inventors, technicians and engineers at the school/university/technikon interface in this emerging small nation located in Southern Africa.

ACKNOWLEDGEMENTS

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Table 1. Concurrence between the policy agreements of samples of 171 Lesotho primary and high school science/technology teachers and 368 Lesotho senior high school science/technology students in 1999.

Suggestions for improvement	Teachers (N = 171) % Agree	Teachers (N = 171) % Disagree	Students (N = 368) % Agree	Students (N = 368) % Disagree	chi-square	p-value
1. More real life skills in S&T	97	2	83	17	21.92	0.0000**
2. More gender issues in S&T	50	47	66	32	11.65	0.0006**
3. More environmental issues	88	12	82	17	1.69	0.1936
4. Science for community dev't.	76	23	58	40	15.59	0.0001**
5. More attention to language issues	49	50	40	59	2.90	0.0884
6. More focus on the disadvantaged	85	13	73	24	9.10	0.0026**
7. More competitions in S&T	97	2	96	4	1.53	0.2160
8. More self-discovery in S&T	94	5	80	18	16.23	0.0001**
9. Core plus options in curriculum	75	23	56	40	15.90	0.0001**
10. More primary school S&T	88	11	83	15	1.50	0.2212
11. Wider community consultations	86	11	85	12	0.15	0.6988
12. Computer-aided instruction	81	17	77	20	0.45	0.5033
13. Promoting careers in S&T	91	8	83	12	2.33	0.1270
14. Excitement and adventure	93	5	78	17	15.05	0.0001**
15. Acquiring more resources	97	2	95	3	0.51	0.4738
16. Conducting science campaigns	98	1	91	7	7.14	0.0075**
17. More extramural S&T activities	99	1	88	9	11.33	0.0008**
18. External support and recognition	91	7	82	15	5.81	0.0159*
19. Better teaching methods	98	2	91	7	5.23	0.0222*
20. Science as an entry requirement	61	6	59	37	0.05	0.8173

Note: frequencies, not percentages, have been used for chi-square calculations.
** $p < 0.01$ Highly significant difference between teachers' and students' response patterns on these items.
* $p < 0.05$ Significant difference between teachers' and students' response patterns on these items. The pattern of responses of the science/technology students agrees with the pattern of responses of their science/technology teachers on items 3, 5, 7, 10, 12, 13, 15 and 20.

Table 2: Concurrence between the policy preferences of samples of 171 Lesotho primary and high school science/technology teachers and 368 Lesotho senior high school science/technology students in Lesotho in 1999.

Suggestions for improvement	Teachers (N = 171) Best	Teachers (N = 171) Least	Students (N = 368) Best	Students (N = 368) Least
1. More real life skills in S&T	28	3	15	17
2. More gender issues in S&T	3	54	4	45
3. More environmental issues	18	13	19	34
4. Science for community dev't.	8	27	11	32
5. More attention to language issues	10	41	8	93
6. More focus on the disadvantaged	7	19	4	15
7. More competitions in S&T	19	11	78	22
8. More self-discovery in S&T	26	4	59	19
9. Core plus options in curriculum	8	12	18	49
10. More primary school S&T	23	13	57	50
11. Wider community consultations	5	18	3	26
12. Computer-aided instruction	12	18	44	36
13. Promoting careers in S&T	8	5	26	21
14. Excitement and adventure	5	5	9	16
15. Acquiring more resources	59	8	127	16
16. Conducting science campaigns	12	4	63	32
17. More extramural S&T activities	18	7	36	15
18. External support and recognition	8	12	14	15
19. Better teaching methods	34	8	58	26
20. Science as an entry requirement	7	31	5	44

APPENDIX 2

Photocopies of some of the suggestions made by the respondents during the developmental studies of potential instruments

IMPROVING SCIENCE/MATHEMATICS/TECHNOLOGY IN THE NEW SOUTH AFRICA

As an EXPO entrant, and as a young science/mathematics enthusiast in the New South Africa, my recommendations for improving the learning of the sciences in South African schools, as part of the Reconstruction and Development Programme, numbered in order of importance, are as follows:-

(   ) Improvements can occur by giving more attention to special African topics in the sciences and less attention to topics of common international interest in mathematics/science.

(   ) The sciences can be improved in schools by paying more attention to gender issues (men and women in mathematics/science; mathematics and science topics for both girls' interests and boys' interests, etc.)

(4) The mathematics/sciences can be improved in schools by introducing more technical skills, trade ~~skills~~, industrial ~~skills~~, manufacturing ~~skills~~, marketing ~~skills~~, and technological ~~skills~~ in real life situations; and having less academic/book learning.

(   ) An improvement could be to concentrate more on current South African environmental crises (problems and solutions) (problems of soil loss, health care, sanitation, air pollution, electricity supply, destruction of plant and animal species, etc.)

(3) Improvements could occur by using mathematics/science to help the community to develop itself socially and economically, ~~and~~ by looking into solutions to solve political, labour, citizenship and ethical problems in society.

(   ) The sciences can be improved in schools by paying more attention to language issues (technical terms, mother-tongue instruction, cultural meanings of words, learning at the proper level of understanding, English as a second language, etc.)

(   ) Mathematics/science can be improved in schools by having the disadvantaged South African majority as its focal point, with the government using education to make up for a lack of equipment and resources in some schools.

(   ) More competitions and enterprises could be encouraged between schools and within schools.

(2) More use could be made of self-discovery and self-teaching methods in mathematics/science, with students designing more of their own experiments and inventions.

(5) Science/mathematics curricula could be changed to have a small, compulsory core syllabus plus many free choice options which students could choose individually for their own personal relevance and pleasure.

( ) The mathematics/sciences could be improved by giving all pupils in the primary schools much more science and technology than they receive at present.

( ) Less time could be spent learning existing mathematics/science textbook facts and more time could be spent developing thinking skills, creativity skills, problem-solving skills and fieldwork skills.

( ) All interested groups in the communities should be consulted for suggestions on how they think mathematics/science can be improved in schools.

( ) The mathematics/sciences can be improved in schools by seeing and feeling and experiencing them in a more "human" way, (i.e. maths/science/technology should not appear to be merely as an objective, neutral, impersonal body of knowledge).

...me as
...tegory
5

each item

→ Sentences too long

IMPROVING SCIENCE/MATHEMATICS/TECHNOLOGY IN THE NEW SOUTH AFRICA

As an EXPO entrant, and as a young science/mathematics enthusiast in the New South Africa, my recommendations for improving the learning of the sciences in South African schools, as part of the Reconstruction and Development Programme, numbered in order of importance, are as follows:-

✓ (7) Improvements can occur by giving more attention to special African topics in the sciences and less attention to topics of common international interest in mathematics/science.

(   ) The sciences can be improved in schools by paying more attention to gender issues (men and women in mathematics/science; mathematics and science topics for both girls' interests and boys' interests, etc.)

✓ (6) The mathematics/sciences can be improved in schools by introducing more technical skills, trade skills, industrial skills, manufacturing skills, marketing skills, and technological skills in real life situations; and having less academic/book learning.

✓ (1) An improvement could be ~~to~~ concentrate more on current South African environmental crises [issues] (problems of soil loss, health care, sanitation, air pollution, electricity supply, destruction of plant and animal species, etc.)

✓ (9) Improvements could occur by using mathematics/science to help the community to develop itself socially and economically, and solve political, labour, citizenship and ethical problems in society.

(   ) The sciences can be improved in schools by paying more attention to language issues (technical terms, mother-tongue instruction, cultural meanings of words, learning at the proper level of understanding, English as a second language, etc.)

(   ) Mathematics/science can be improved in schools by having the disadvantaged South African majority as its focal point, with the government using education to make up for a lack of equipment and resources in some schools.

(   ) More competitions and enterprises could be encouraged between schools and within schools.

✓ (3) More use could be made of self-discovery and self-teaching methods in mathematics/science, with students designing more of their own experiments and inventions.

✓ (4) Science/mathematics curricula could be changed to have a small, compulsory core syllabus plus many free choice options which students could choose individually for their own personal relevance and pleasure.

( ) The mathematics/sciences could be improved by giving all pupils in the primary schools much more science and technology than they receive at present.

(6) Less time could be spent learning existing mathematics/science textbook facts and more time could be spent developing thinking skills, creativity skills, problem-solving skills and fieldwork skills. } same as 9.

( ) All interested groups in the communities should be consulted for suggestions on how they think mathematics/science can be improved in schools.

(1) The mathematics/sciences can be improved in schools by seeing and feeling and experiencing them in a more "human" way, (i.e. maths/science/technology should not appear to be merely as an objective, neutral, impersonal body of knowledge).

o long. sentences

Seperate ranking bracket

APPENDIX 3a

The 17-item survey instrument

(Instrument adapted for a specific region)

NORTH WEST DEPARTMENT OF EDUCATION

CIRCLE

MALE	FEMALE

COMPUTERS
GEOGRAPHY
TECHNOLOGY
PHYSICAL SCIENCE
BIOLOGY

IMPROVING SCIENCE/ TECHNOLOGY IN THE NORTH WEST PROVINCE

As part of the Reconstruction and Development Programme, I think in the North West Science/ Technology can be improved by:-

	CIRCLE	
	AGREE	DISAGREE
1. **INTRODUCING MORE REAL LIFE SKILLS INTO SCIENCE** (e.g. technical, trade, industrial, commercial, farming, mining, manufacturing, marketing and technological skills).	[A]	[B]
2. **PAYING MORE ATTENTION TO GENDER ISSUES** (men and women in science; topics that cater for girls' interest and boys' interest; solutions to the existing gender problems in the North West).	[A]	[B]
3. **CONCENTRATING MORE ON NORTH WEST ENVIRONMENTAL ISSUES** (e.g. problems of soil loss and possible solutions, health care, sanitation, air pollution, electrical supply, conservation of plant and animal species).	[A]	[B]
4. **USING THE SCIENCES TO ADVANCE AND DEVELOP THE NORTH WEST COMMUNITY SOCIALLY AND ECONOMICALLY** (e.g. to help solve political, labour, citizenship, social and ethical problems in the North West).	[A]	[B]
5. **PAYING MORE ATTENTION TO LANGUAGE ISSUES IN THE NORTH WEST** (such as teaching cultural meaning of scientific terms; teaching of science using the mother-tongue e.g. Setswana or Afrikaans or English; learning to understand terms and language; scientific English as a second language).	[A]	[B]
6. **HAVING THE DISADVANTAGED MAJORITY IN THE NORTH WEST AS ITS FOCAL POINT**(i.e. using science/technology education to empower communities address their local problems resourcefully, e.g. housing, sanitation etc.).	[A]	[B]
7. **ENCOURAGING COMPETITIONS**, with more enterprises to be organised between schools and within schools in the North West (e.g. students participating in EXPO, science fairs, science Olympiad, science essay writing etc.).	[A]	[B]
8. **MAKING MORE USE OF SELF-DISCOVERY AND SELF-TEACHING** (i.e. students designing their own experiments and fieldwork and developing skills for problem solving, creative thinking etc.).	[A]	[B]

9. **CHANGING CURRICULA TO A COMPULSORY BASIC SYLLABUS PLUS OPTIONS** (i.e. students do compulsory science modules and choose others freely and individually for their own personal relevance and interest). [A] [B]

10. **GIVING ALL PUPILS IN THE PRIMARY SCHOOLS IN THE NORTH WEST MUCH MORE BASIC SCIENCE AND TECHNOLOGY** than they receive presently. [A] [B]

11. **ALL INTERESTED GROUPS IN THE NORTH WEST SHOULD BE CONSULTED** on how they think science can be improved in schools. [A] [B]

12. **USING COMPUTER-AIDED INSTRUCTION AND COMPUTER INTERFACING AS PART OF SCIENCE EXPERIMENTS** (e.g. to collect, display, analyse and plot data; and to explain science concepts). [A] [B]

13. **PROMOTING CAREERS IN SCIENCE AND TECHNOLOGY AMONG SCHOOL PUPILS IN THE NORTH WEST.** [A] [B]

14. **SHARING AND INCREASING THE INTELLECTUAL EXCITEMENT AND SENSE OF ADVENTURE, WHICH THE SCIENCE OFFERS** (its benefits, optimism, encouragement, spirit and challenge to the North West pupils). [A] [B]

15. **LEARNING SCIENCE THROUGH THE AFRICAN INDIGENOUS TECHNOLOGY AND CULTURE, AND THROUGH THE AFRICAN WORLD VIEW OF LIFE AND THOUGHT SYSTEM** (i.e. preserving what is good in African culture and tradition; regarding science as sacred; learning science through African theories of space and time, the kinship system, customs, images, symbols, forms of expression, values, feelings and interpretations) [A] [B]

(a) THE <u>**TWO BEST**</u> WAYS OF IMPROVING SCHOOL SCIENCE/TECHNOLOGY IN THE NORTH WEST PROVINCE MENTIONED ABOVE ARE NUMBERS ( ) AND ( ).

(b) THE <u>**TWO LEAST IMPORTANT**</u> RECOMMENDATIONS MENTIONED ABOVE ARE NUMBERS ( ) AND ( ).

ON THE BACK OF THIS SHEET YOU MAY WISH TO GIVE REASONS FOR SOME OF YOUR ANSWERS , OR YOU MAY WISH TO MAKE OTHER SUGGESTIONS FOR IMPROVING SCIENCE IN THE NORTH WEST PROVINCE.

Circle AGREE or DISAGREE for each item

KEY: [A] = AGREE

[B] = DISAGREE

P. T. O.

1. Reasons for choosing numbers _____ and _____ as the two best ways for improving Science/Technology in the North West Province are ______________________________

2. Reasons for choosing numbers ______ and ______ as the two least important recommendations for improving Science/Technology in the North West are

3. What other suggestions can you give for improving Science /Technology in the North West? Please give reasons for your answer.

Thank You

APPENDIX 3b

The 20 - item survey instrument

Please tick: Female Student

Male Teacher

IMPROVING SCIENCE IN HIGH SCHOOLS IN LESOTHO BY THE YEAR 2000

I think that the teaching and learning of science in Lesotho schools can be improved by:-

CIRCLE

1. INTRODUCING MORE REAL LIFE SKILLS INTO SCIENCE (e.g technical, trade, industrial, commercial, manufacturing and marketing skills for Lesotho.) [A] [D]

2. PAYING MORE ATTENTION TO GENDER ISSUES (men and women in science, topics for both boys' and girls' interests; solutions to gender problems, etc.) [A] [D]

3. CONCENTRATING MORE ON LESOTHO ENVIRONMENTAL ISSUES (e.g problems of soil loss and possible solutions, health care, sanitation, air pollution, electricity supply, conservation of plants and animal species, etc.) [A] [D]

4. USING SCIENCE TO ADVANCE AND DEVELOP THE LESOTHO COMMUNITY SOCIALLY AND ECONOMICALLY (i.e to help solve political, labour, citizenship, social and ethical problems in Lesotho society.) [A] [D]

5. PAYING MORE ATTENTION TO LANGUAGE ISSUES (such as technical terms; using the mother-tongue (Sesotho) to give instruction; cultural meanings of scientific words; learning to understand terms and language; scientific English as a second language, etc.) [A] [D]

6. HAVING THE UNDERPRIVILEGED MAJORITY AS ITS FOCAL POINT. Using science education to empower Lesotho communities to address their local problems resourcefully. [A] [D]

7. **ENCOURAGING MORE COMPETITIONS IN SCIENCE** with more enterprises to be organised between schools in Lesotho and within schools, such as science quizes. [A] [D]

8. **MAKING MORE USE OF SELF DISCOVERY AND SELF TEACHING** (i.e students designing more of their own experiments and field work and developing skills of problem solving, creativity, thinking, etc.) [A] [D]

9. **CHANGING THE SCIENCE CURRICULUM TO A COMPULSORY CORE SYLLABUS PLUS MANY OPTIONS,** which students could choose freely and individually for their own personal relevance and pleasure and making the syllabi more compatible with the needs of tertiary institutions in Lesotho. [A] [D]

10. **GIVING ALL PUPILS IN LESOTHO PRIMARY SCHOOLS MUCH MORE BASIC SCIENCE.** Giving primary school pupils much more science education than they are learning at present, i.e before they come to high schools. [A] [D]

11. **ALL INTERESTED GROUPS IN THE LESOTHO COMMUNITIES SHOULD BE CONSULTED.** Community consultations should be made on how science can be improved in high schools by the year 2000. [A] [D]

12. **USING COMPUTER - AIDED INSTRUCTION AND COMPUTER INTERFACING AS PART OF SCIENCE EXPERIMENTS IN LESOTHO** (e.g to collect, display, combine, analyse and plot data.) [A] [D]

13. **PROMOTING CAREERS AND JOB PROSPECTS IN SCIENCE AMONG SCHOOL PUPILS IN LESOTHO.** [A] [D]

14. **SHARING AND INCREASING THE INTELLECTUAL EXCITEMENT AND SENSE OF ADVENTURE WHICH SCIENCE OFFERS** (its hopes, benefits, optimism, encouragement, spirit and challenge in Lesotho.) [A] [D]

15. **<u>ACQUIRING MORE RESOURCES FOR SCHOOLS IN LESOTHO</u>**
(i.e libraries, library books, laboratories, science equipment, computers, etc.) [A] [D]

16. **<u>CONDUCTING SCIENCE CAMPAIGNS</u>**
(i.e raising people's awareness about the benefits of science for Lesotho and offering more bursaries and scholarships for students to study science.) [A] [D]

17. **<u>MORE EXTRAMURAL SCIENCE ACTIVITIES</u>**
(in the form of science excursions, fieldwork, more practical work, science clubs, projects, etc.) [A] [D]

18. **<u>HAVING EXTERNAL SUPPORT AND RECOGNITION FOR SCIENCE STUDENTS</u>**
(encouragement from parents; and putting monetary awards at various levels of science education in Lesotho.) [A] [D]

19. **<u>BETTER TEACHING METHODS</u>.**
(Good science teaching methods are those which promote interest in the study of the physical and natural world and society; and which encourage the practical aspect of the subject.) [A] [D]

20. **<u>ENCOURAGING FUTURE PROSPECTS IN SCIENCE</u>.**
Making science as an entry requirement to all science-oriented study at tertiary institutions; and at least one science subject as an entry requirement to non-science tertiary institutions. [A] [D]

21. Fill in the numbers of four items:-
(a) I THINK THAT THE TWO BEST WAYS OF IMPROVING HIGH SCHOOL SCIENCE IN LESOTHO, OF ALL THOSE MENTIONED ABOVE, ARE NUMBERS: (   ) AND (   ).

(b) I THINK THAT THE TWO LEAST IMPORTANT RECOMMENDATIONS FOR SCIENCE EDUCATION IN LESOTHO MENTIONED ABOVE ARE NUMBERS: (   ) AND (   ).

Circle AGREE or DISAGREE for each item.
Key: [A] = AGREE
[D] = DISAGREE

IN THE SPACES PROVIDED BELOW, YOU ARE ENCOURAGED TO GIVE REASONS FOR SOME OF YOUR ANSWERS; OR YOU MAY BRING UP OTHER SUGGESTIONS WHICH YOU FEEL ARE IMPORTANT FOR IMPROVING SCIENCE EDUCATION IN LESOTHO.

In item 21, my reasons for choosing numbers.......... and.........as the two best ways for improving science education in Lesotho are:

....
....
....
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....

My reasons for choosing numbers............and.........as the two least important recommendations for improving science education in Lesotho are:

....
....
....
....
....
....
....

What other suggestions can you give for improving science teaching and learning in Lesotho?

Please give reasons for your suggestions.

....
....
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....
....

THANK YOU !

APPENDIX 3c

A Turkish version of the 20 – item instrument

"FEN BİLİMLERİ EĞİTİMİNİN GELİŞTİRİLMESİ"

LÜTFEN UYGUN OLANINI (X) İLE İŞARETLEYİNİZ.

BAY............	ÖĞRENCİ ...X...	(6-8) İLK ÖĞRETİM	ÜNİVERSİTE..............
BAYAN.......	ÖĞRETMEN	(9-11) ORTA ÖĞRETİM ...X.......	SINIF....................

A. AŞAGIDA VERİLEN MADDELLERİN FEN BİLİMLERİ EĞİTİMİNİN GELİŞTIRLİMESİNE KATKIDA BULUNACAĞINA İNANIYORSANIZ KATILIYORUM ; İNANMIYORSANIZ KATILMIYORUM SEÇENEĞİNİ İŞARETLEYİNİZ.

		KATILIYORUM	KATILMIYORUM
1.	**FEN BİLİMLERİ EĞİTİMİNDE GÜNLÜK YAŞAM İLE İLGİLİ KONULARA DAHA FAZLA YER VERİLMELİ** (Teknik, ticari,ekonomik, politik ve endüstriyel konular gibi.)	(X)	( )
2.	**CİNSİYET SORUNLARINA DAHA FAZLA DİKKAT EDİLMELİ** (Her iki cinsi ilgilendiren konularin seçilmesi, kadın-erkek eşitliği gibi)	(X)	( )
3.	**TÜRKİYE'NİN ÇEVRE SORUNLARINA DAHA FAZLA YÖNELİNMELİ** (Erozyon, Çevre kirliliği ve çözümleri, bitki ve hayvanların korunması gibi.)	( )	(X)
4.	**TÜRK TOPLUMUNU SOSYAL VE EKONOMİK AÇIDAN KALKINDIRMAK İÇİN FEN BİLİMLERİ DAHA FAZLA KULLANILMALI** (Sosyal, politik, ekonomik ve etnik problemlere bilimsel çözümler getirme gibi.)	( )	(X)
5.	**FEN BİLİMLERİ EĞİTİMİNDEKİ DİL PROBLEMLERİ DAHA FAZLA DİKKATE ALINMALI.** (Teknik terimlerin açıklanması, anadilde ve İngilizce eğitimde yaşanan problemlerin çözümü gibi.)	(X)	( )
6.	**FEN BİLİMLERİ EĞİTİMİNİN İÇERİĞİ AZ GELİŞMİŞ BÖLGELER DİKKATE ALINARAK HAZIRLANMALI** (Yerel sorunların çözümleri ve yöresel problemlerin bilimsel ifadesi gibi)	( )	(X)
7.	**FEN BİLİMLERİ ETKİNLİKLERİ DÜZENLENİP TEŞVİK EDİLMELİ** (Okul içi, okullar arası ve ulusal bilim ve proje yarışmaları gibi)	(X)	( )
8.	**ÖĞRENCİLERE KENDİ BAŞLARINA BULUP ÖĞRENME BECERİLERİLERİ DAHA FAZLA KAZANDIRILMALI** (Öğrencilerin kendi deney, çalışma ortam ve olanaklarını kendilerinin hazırlaması gibi)	(X)	( )
9.	**FEN BİLİMLERİ EĞİTİM MÜFREDATI FARKLI KİTAP VE İÇERİKLERLE ÇOK SEÇENEKLİ HALE GETİRİLMELİ** (Öğrencinin kendi istek ve ilgisine göre özgürce kitap ve içerik seçmesi)	(X)	( )
10.	**İLKÖĞRETİM MÜFREDATINDA TEMEL FEN BİLİMLERİ EĞİTİMİ DAHA YOĞUN OLMALI**	(X)	( )
11.	**TÜRKİYE'DEKİ BÜTÜN İLGİLİ GRUPLARA FEN BİLİMLERİ EĞİTİMİN GEREKSİNİMLERİ KONUSUNDA DANIŞILMALI** (Müfredat geliştirmenler, eğitim uzmanları, Milli Eğitim Bakanlığının ilgili birimleri gibi)	( )	( )
12.	**BİLGİSAYAR DESTEKLİ EĞİTİMİN FEN BİLİMLERİ EĞİTİMİNİN BİR PARÇASI OLARAK KULLANILMALI**	(X)	( )
13.	**ÖĞRENCİLERE FEN BİLİMLERİNDE İŞ VE KARİYER OLANAKLARI SAĞLAMANMALI**	(X)	( )
14.	**FEN BİLİMLERİ EĞİTİMİNİN SAĞLADIĞI ENTELLEKTÜEL DÜŞÜNCENİN GELİŞTİRİLİP DESTEKLENMELİ**	( )	(X)

		KATILIYORUM	KATILMIYORUM
15.	**OKULLARA DAHA FAZLA ARAÇ-GEREÇ VE KAYNAKLAR SAĞLANMALI** (Kütüphane, laboratuvar, laboratuvar malzemesi ve bilgisayar gibi)	(X)	( )
16.	**FEN BİLİMLERİ EĞİTİMİNİ DESTEKLER MAHİYETTE TOPLUMSAL KAMPANYALAR DÜZENLENMELİ.** (Toplumun bilinçlendirilmesi, okullar için burs ve her türlü desteğin alınması.)	(X)	( )
17.	**BİLİMSEL AKTİVİTELERE DAHA FAZLA YER VERİLMELİ** (Bilimsel geziler, bilim toplulukları, ve bilimsel projeler gibi.)	(X)	( )
18.	**FEN BİLİMLERİ İLE İLGİLENEN ÖĞRENCİLERE HER TÜRLÜ MADDİ VE MANEVİ DESTEK SAĞLANMALI**	(X)	( )
19.	**FEN BİLİMLERİ EĞİTİMİNDE DAHA FAZLA VE KALİTELİ METODLAR GELİŞTİRİLİP KULLANILMALI.**	(X)	( )
20.	**FEN BİLİMLERİ HER TÜRLÜ SINAV SONUCUNDA ALINACAK PUAN HESABINDA DAHA FAZLA ROL ALMALI** (Üniversite sınavında veya lisans üstü sınavlarda)	(X)	( )

B. **AŞAĞIDAKİ BOŞLUKLARI YUKARIDAKİ 20 MADDEDEN 4 MADDENİN NUMARALARINI KULLANARAK DOLDURUNUZ:**

a) Yukarıdaki seçeneklerden size göre hangi ikisi fen bilimleri eğitiminin gelişmesinde EN FAZLA ÖNEM taşımaktadır:
(....1....), (..19....). 1: it provides better understanding, makes science fun

b) Bu maddeleri fen bilimleri eğitiminin gelişiminde EN ETKİLİ iki seçenek olarak seçmemin sebepleri şunlardır:
Eğer fen bilimleri eğitiminde günlük yaşam ile ilgili konulara yer verilirse insanların bunları kavramasında özel bir çaba harcaması gerekmeyecektir. Yeni ve kaliteli metodlar sayesinde öğrencileri sıkmadan ve kolayca eğitmek mümkün olacaktır.

c) Yukarıdaki seçeneklerden size göre hangi ikisi fen bilimleri eğitiminin gelişmesinde EN AZ ÖNEM taşımaktadır:
(...20....), (...4....). 20: learning and getting high mark are not the same thing.

d) Bu maddeleri fen bilimleri eğitiminin gelişiminde EN AZ ETKİLİ iki seçenek olarak seçmemin sebepleri şunlardır:
Sınav yoluyla insanlar korkutularak öğrencilere bilgi ezbere taşımakla birlikte sınavdan sonra unutulacaktır. Evrensel bir bilimin Türk toplumunun sorunlarını çözmek için kullanılması oldukça saçmadır.

C. **BUNLARIN DIŞINDA ÖNERİLERİNİZ VARSA, LÜTFEN SEBEPLERİYLE BİRLİKTE YAZINIZ:**

....

Katkılarınızdan dolayı teşekkür ederiz.

Response frequencies for a sample of N = 172 Turkish students, teachers and lecturers

Suggestions for improvement	Agree	Disagree	Best choice	Least choice
1. More real life skills in science	165	11	45	6
2. More gender issues in science	96	71	1	60
3. More environmental issues	149	22	7	18
4. Science for community development	152	18	10	14
5. More attention to language issues	140	26	14	19
6. More focus on the disadvantaged	101	62	1	29
7. More competitions in science	152	18	7	11
8. More self-discovery in science	161	11	51	5
9. Core plus options in curriculum	140	31	11	16
10. More primary school science	112	60	14	36
11. Wider community consultations	146	23	4	12
12. Computer-aided instruction	151	26	21	5
13. Promoting careers in science	151	17	15	9
14. Excitement and adventure	156	12	9	4
15. Acquiring more resources	165	7	32	4
16. Conducting science campaigns	152	17	3	10
17. More extramural science	160	9	15	6
18. External support and recognition	153	17	12	4
19. Better teaching methods	165	6	41	1
20. Science as an entry requirement	107	58	15	27

APPENDIX 3d

A Xhosa version of the 17 – item instrument

IBANGA	
6-8	9-10

UMNTU OBHINQILEYO
INDODA

IZIBALO
IIKHOMMPYUTHA
IJOGRAFI
INZULULWAZI NGOBUGCISA
IFIZIKISI
IBHAYOLOJI

UNYUSO-MGANGATHO LWEZENZULULWAZI/IZIBALO/NENZULULWAZI NGEZOBUGCISA KUMZANTSI AFRIKA OMTSHA

Ngokubhekiselele kwinkqubo yophuhliso nophuculo mgangatho
Ndicinga okokuba ufundiso lwezibalo nenzuluwazi ezikolweni lunga-phuculwa ngokuthi:

RHANGGQELA
NDIYAVUMA ANDIVUMI

1. **UKUFAKA OBONE BUCHULE BOBOMI KWEZE NZULULWAZI**
(umzkl. Inzululwazi ngezobugcisa, urhwebo, amashishini, intengiso, ukwenziwa kwezinto ezifektri, nobuchule kwezobugcisa) [NDI] [ANDI]

2. **UKUTHATHELA INGQALELO UMCIMBI WOBUNI**
(Umzkl. Amadoda nabafazi kwiZibalo/iNzuluwazi/neNzululwazi, ngezobugcisa; izihloko ngezinto ezinika umdla kumantombazana namakhwenkwe; izisombululo kwiingxaki ezikhoyo ngobuni, njl-njl.) [NDI] [ANDI]

3. **UKUNIKA ILISO IKAKHULU KWIZINTO ZENDALO EMZANTSI-AFRIKA**
(Njengeengxaki zokungakhathalelwa komhlaba nesisombululo, ukukhathalewa kwempilo. ezococeko, ungcoliso lomoya. ubonelelo ngombane. ulondolozo lomhlaba noluhlu lwezilwanyana, njl-njl.) [NDI] [ANDI]

4. **UKUSEBENZISA EZENZULULWAZI JIKELELE NOKUNYUSA UMZI NGOKWASENTLALWENI NAKWEZOQOQOSHO.**

(Umzkl. ukunceda ekusombululeni iingxaki ezibhekiselele kwezombuso, emisebenzini, kubumi, ekuhlaleni nakwimikhwa esesikweni) [NDI] [ANDI]

5. **UKUTHATHELA INGQALELO UMCIMBI WEELWIMI**

(Njengamagama obuchule, imigaqo yolwimi lokuzalwa, intsingiselo echubekileyo yamagama eNzululwazi, ukufunda nokuwalandela kakuhle amagama nolwimi, ukufundwa kwesilungu njengolwimi lwesibini, njl-njl.) [NDI] [ANDI]

6. **UKWENZA INXALENYE YABO BANGAZANGE BALIFUMANA ITHUBA KUMZANTSI AFRIKA BABENGOYENGA NDOQO KWEZI ZIFUNDO,**

ukusebanzisa le mfundo ukunyusa umgangathho wokuhlala nakuhlangabenzana neengxaki zokuhlala ngobuqili [NDI] [ANDI]

7. **UKUKHUTHAZA UKHUPHISWANO NGAKUMBI**

kwenziwe ukhuphiswanu loshishino lwezikolo (ngaphandle nanagaphakathi ezikolweni) [NDI] [ANDI]

8. **UKWENZA UKUBA ABANTU BASEBENZISE IINGCINGA NEENGQIQO EZIZEZABO**

(Umzkl. Abafundi basebenzise abakwaziyo nabakubonayo kuphando olulolwabo, babenobuchule bokusombulula iingxaki ngokunokwabo, basebenzise iziphiwo zabo zokuyila nokucinga, njl-njl) [NDI] [ANDI]

. **UKUGUQULA ULUDWE LWEZIFUNDO (IKHARIKYULAM) LUBE LUQINGQO LWEZIFUNDO (ISILABHASI) OLUNYANZELEKILEYO KWAKUNYE NOLUNGANYANZELEKANGA,** [NDI] [ANDI]

apho abafundi bakubanalo ilungelo lokuzikhethela ngokuphathelele kwiimbono neemfuno zabo.

). **UKUNIKA BONKE ABAFUNDI ABASEKUMABANGA APHANTSI**

olona lwazi lusisiseko lweNzululwazi, kunokuba belufumana okweli lixa (oko kukuthi phambi kokuba baye kumabanga aphakamileyo). [NDI] [ANDI]

11. ONKE AMAQELA NGAMAQELA ASEKUHLALENI ANOMDLA KWEZI ZIFUNDO MAKAMENYWE. [NDI] [ANDI]
kujongwe indlela acinga ngayo ngeZibalo/iNzululwazi/kwakunye neNzululwazi ngezobugcisa ezikolweni kulo nyaka.

12. UKUSEBENNZISA ULWAZI OLUGCINWA KOOMATSHINI NJENGENXENYE YOMFUNISELO WENZULLULWAZI [NDI] [ANDI]
(Umzkl. Ukuqokelela, ukubonisa, ukudibanisa, ukuchonga kwakunge nokuyila ulwazi)

13. UKUKHUTHAZA INKQUBELA-PHAMBILI YOBOMI KWI-Nzululwazi/iZibalo kwakunye neNzululwazi ngobugcisa kubafundi [NDI] [ANDI]

14. UKWABELANA NOKWANDISA IMVUSELELEKO YENGQONDO NOBULUMKO BODELONGOZI OLUNIKWA YINZULULWAZI.
(Umzkl. ithemba, uncedo, ukulindela okuhle, inkuthazo, umoya omhle kwakunye nokucela umngeni) [NDI] [ANDI]

15. UKUFUNDA INZULULWAZI NGEZINTO ZOBUCHULE UBUGCISA KWAKUNYE NENKCUBEKO YASE AFRIKA, ?MBONO ZELIZWE LASE-AFRIKA NGOBOMI NANGENGQIQO EMISIWEYO
(oko kukuthi ukugcina okona kulungileyo ngenkcubeko kunye namasiko ase-Afrika, iNzululwazi ithathwe njengento engcwele, kufundwe iNzululwazi ngeengcinga zase-Afrika ngokuphangaleleyo, iingcinga ezimiseweyo ngobudlelwane, izithethe, imifanekiso, imiqondiso, iindlela zokubonisa, iinqobo ezisemgangathweni, iimvakalelo kwakunye nenkcazo ngokupheleleyo) [NDI] [ANDI]

ezona ndlela zimbini zokuphucula umgangatho weNzululwazi/iZibalo neNzululwazi ngezobugcisa apha ngentla zezi : (   )   No-(   )

ezona ndlela zimbini ezingabalulekanga kangako apha ngentla zezi: (   )   No-(   )

Rhangqela U [ndiyavuma] okanye [andivumi]	
isiboniso	: [ndi] - ndiyavuma : [andi} - andivuvmi

APPENDIX 4a

A copy of the interview guide (for teachers)

INTERVIEW GUIDE (for teachers)

SECTION 1: TEACHING PROBLEMS

1. What are your views about the way in which science is taught in Lesotho high schools?
2. What do you think could be done to improve the teaching of science?
3. What can you say about the way science is learned?
4. Do you think the way it is learned is influenced by teaching methods?
5. What do you think could be done to improve the situation?

SECTION 2: ACQUIRING MORE RESOURCES

6. Is there a need to acquire more resources for Lesotho schools?
7. Do you think the already existing materials are efficiently used in schools? Explain.
8. Do you think if all schools could 'adequately' be supplied with resources, then the teaching and learning of science might improve?
9. Which resources do you think should be given the first priority and why?
10. Do you think these resources would be efficiently used in schools?
11. What do you think should be done to equip science teachers with skills for proper usage of the resources?
12. Do you think our pupils have the reading culture? If "not", what do you think should be done to help them? If "yes", please justify your answer.

SECTION 3: MORE COMPETITIONS IN SCIENCE

13. Do you think competitions in science could be used in promoting the teaching and learning of science? Explain.

Two sides were considered

14. Do you think science teachers have 'adequate' skills to prepare students for science competitions?

SECTION 4: HAVING BETTER TEACHING METHODS

15. Which teaching methods do you think are commonly used by Lesotho science teachers?

16. What do you think might be the cause for not using other teaching methods?

17. From your own point of view, do you see a need for Lesotho science teachers to be upgraded in some teaching methods? Explain.

18. Which teaching methods would you prefer to be mostly used in science lessons and why?

19. What do you normally do, when students do not understand what you are trying to put across in English?

APPENDIX 4b

A copy of the interview guide (for students)

INTERVIEW GUIDE (for students)

1. Na u rata 'science' ? Ho joalo (ha ho joalo) hobaneng?
   (Do you like science as a subject? If so (not) why?)

2. 'Science' le e rutoa joang?
   (How are you taught science in your school?)

3. U ka rata ho rutoa 'science' joang?
   (How would you like to be taught science?)

4. Ke eng e u thabisang ka ntlong ea boithutelo ea 'science'?
   (What interests you in science lesson?)

5. Le ea 'laboratory' ha kae ka beke, ho ilo etsa li 'practical'?
   (How often do you go to the laboratory per week, for practical work?)

6. Le iketsetsa li 'practical' ka bo lona kapa mosuoe kapa mosuoetsana o le etsetsa tsona.)
   (Do you carry out the practicals yourselves (students) or your teacher carries out demonstrations?)

7. Le fella hantle ka 'laboratory'?
   (Is the laboratory spacious enough to accommodate every member of class for practical work?)

8. Le lebelletsoe ho etsa raporoto?
   Are you expected to write a lab report?

9. U ka rata ho rutoa 'science' ka puo efe? Hobaneng?
   (In what language would like to be taught science? Why?)

10. Ho na le nako eo u eng u lakatse ho botsa lipotso ka sesotho?
    (Are there some cases when you feel you could be given an opportunity to ask questions in Sesotho?)

11. Ba sebetsang hantle haholo thutong ea 'science', ke banana kapa bashanyana? Lebaka ke lefe?
    (Do boys or girls perform better in science? why is this the case?)

12. Ho ka tsotelleha hore bashanyana le banana ba rutoe ba arohane? Hobaneng?

(Would it matter if boys were taught on their own and girls on their own? If so (not), why?)

13. Na sekolo sa heno se nka karolo litlholisanong tsa 'science'? joang?
Haeba ha ho joalo, u ka rata hore se kenele litlholisano tsa mofuta o joalo? hlalosa.
(Is your school involved in science competitions? If so, how? If not, would you like your school to be involved in competitions and why?)

APPENDIX 5

Photocopies of some of the responses for the choice of best/least important policy recommendations, and suggestions on more issues to be included for the improvement of science and technology teaching and learning

IN THE SPACES PROVIDED BELOW, YOU ARE ENCOURAGED TO GIVE REASONS FOR SOME OF YOUR ANSWERS; OR YOU MAY BRING UP OTHER SUGGESTIONS WHICH YOU FEEL ARE IMPORTANT FOR IMPROVING SCIENCE EDUCATION IN LESOTHO.

In item 21, my reasons for choosing numbers 16 **and** 12 **as the two best ways for improving science education in Lesotho are:**

-Many students do not fully complete their schooling because of financiall problem so if bursaries are offered to students nothing will stand on their way of learning.
-Computers save time thus one does not take a long time to plot datas

My reasons for choosing numbers 10 **and** 13 **as the two least important recommendations for improving science education in Lesotho are:**

P Students in primary schools are not fully matured so ~~their~~ they need not to be taught things that are beyond their way of understanding.

As there are so many students in high schools, they would not all find jobs.

What other suggestions can you give for improving science teaching and learning in Lesotho?
Please give reasons for your suggestions.

Competitions should be held at each and every month and the winners should be awarded so that many students will compete in competitions.

Increasing of salaries

THANK YOU !

IN THE SPACES PROVIDED BELOW, YOU ARE ENCOURAGED TO GIVE REASONS FOR SOME OF YOUR ANSWERS; OR YOU MAY BRING UP OTHER SUGGESTIONS WHICH YOU FEEL ARE IMPORTANT FOR IMPROVING SCIENCE EDUCATION IN LESOTHO.

In item 21, my reasons for choosing numbers..12... and..16..as the two best ways for improving science education in Lesotho are:
Students can be encouraged by the bursaries giving given to science students and as a result the will work hard. Another reason is that student can install more information on a computer and that will help very much in his/her studies.

My reasons for choosing numbers...5.....and...13...as the two least important recommendations for improving science education in Lesotho are:
I think that using Sesotho in Science will make things more complicated because there are some words which can't easily be translated to Sesotho. So the student will get confused. It is still appropriate at the moment to use English.

What other suggestions can you give for improving science teaching and learning in Lesotho?
Please give reasons for your suggestions.
Paying less fees and increasing teacher's salaries will help very much. Because they will only concentrate on their work.

THANK YOU !

IN THE SPACES PROVIDED BELOW, YOU ARE ENCOURAGED TO GIVE REASONS FOR SOME OF YOUR ANSWERS; OR YOU MAY BRING UP OTHER SUGGESTIONS WHICH YOU FEEL ARE IMPORTANT FOR IMPROVING SCIENCE EDUCATION IN LESOTHO.

In item 21, my reasons for choosing numbers...10**... and...**3**....as the two best ways for improving science education in Lesotho are:**

in 10 when students at primary level are given much more science education they will not have any difficulties when they reach secondary level and High School level as they will have a broad idea about science while in 3 they will learn science so that in future they will decide on how to develop their country Lesotho and make it a better place to live.

My reasons for choosing numbers....5**.....and**9**......as the two least important recommendations for improving science education in Lesotho are:**

I think when using mother tongue to explain science would not make any progress as sometimes when students finish their studies in tertiary institutions they are given ~~to~~ scholarships to study abroad where the Queen's language is used while in 9 some students are good at science while others are not so everyone has to chose the better place for him/her to stay comfortably.

What other suggestions can you give for improving science teaching and learning in Lesotho?

Please give reasons for your suggestions.

I think to improve science teaching and learning is to make all students in Lesotho to study science whether they like or not and children in primary schools should be given a broad Knowledge of science respectively. Furthermore teachers from primary level to High school level should be given more teaching aids so as to be able to help our poor students in this poor country of our which we like some developments to be done upon it.

THANK YOU !

IN THE SPACES PROVIDED BELOW, YOU ARE ENCOURAGED TO GIVE REASONS FOR SOME OF YOUR ANSWERS; OR YOU MAY BRING UP OTHER SUGGESTIONS WHICH YOU FEEL ARE IMPORTANT FOR IMPROVING SCIENCE EDUCATION IN LESOTHO.

In item 21, my reasons for choosing numbers...15... and...16...as the two best ways for improving science education in Lesotho are:

Many people like to study science and like jobs where science is used but then they have a major obstacle which is money.
If school were given more resources students would be able to get suitable books etc for more information on science

My reasons for choosing numbers...5.......and.20...as the two least important recommendations for improving science education in Lesotho are:

The language would become a major problem if a student has to go and study in other countries where they would have to use other languages.
The primary would find some of what high school students do in science very difficult and confussing

What other suggestions can you give for improving science teaching and learning in Lesotho?

Please give reasons for your suggestions.

Science is a very important subject especially since it is what we live so everybody - not only in the students - should be taught about science. There are some things that uneducated people should be made aware of eg drugs. This can be done by having science clubs in the communities where people can be taught about life.

THANK YOU !

IN THE SPACES PROVIDED BELOW, YOU ARE ENCOURAGED TO GIVE REASONS FOR SOME OF YOUR ANSWERS; OR YOU MAY BRING UP OTHER SUGGESTIONS WHICH YOU FEEL ARE IMPORTANT FOR IMPROVING SCIENCE EDUCATION IN LESOTHO.

In item 21, my reasons for choosing numbers...7.... **and**.19....**as the two best ways for improving science education in Lesotho are:**

In number 7, more competitions in science can make a great improvement as every school would like to win the competition.
Number 19, there should be better teaching methods to make students more interested in science and if a teaching methods is good then it will produce better results.

My reasons for choosing numbers...2.....**and**...10...**as the two least important recommendations for improving science education in Lesotho are:**

2- Science is not all about gender so it is not a solution to the problem of failing ~~...~~ Science.
10- I think in primary schools students are tought according to their level so when they are in high school they are treated at high levels which is to their standard.

What other suggestions can you give for improving science teaching and learning in Lesotho?

Please give reasons for your suggestions.

I think there should be more practicals in Science and also more quizes so that students may get used to how questions are asked.

THANK YOU !

IN THE SPACES PROVIDED BELOW, YOU ARE ENCOURAGED TO GIVE REASONS FOR SOME OF YOUR ANSWERS; OR YOU MAY BRING UP OTHER SUGGESTIONS WHICH YOU FEEL ARE IMPORTANT FOR IMPROVING SCIENCE EDUCATION IN LESOTHO.

In item 21, my reasons for choosing numbers 15 **and** 19 **as the two best ways for improving science education in Lesotho are:**

Lesotho Schools are inadequately equipped. Science needs a hands on approach in order to create a better understanding. More equipment could go a long way towards helping the understanding of Science.
Teaching methods need to be improved to cope with lack of equipment in a majority of schools.

My reasons for choosing numbers 11 **and** 4 **as the two least important recommendations for improving science education in Lesotho are:**

- Consultation with communities may not necessarily improve things. In most cases the rural communities are not well informed and may not give the right guidance.
- Use of Science to develop the community is expensive and not practicable with the poor state of the Country's economy.

What other suggestions can you give for improving science teaching and learning in Lesotho?

Please give reasons for your suggestions.

- Upgrade low grade Science teachers.
- Encourage formation of Science clubs.
- Increase visits to Scientific institutions;
- Enhance dialogue with Science specialists and researchers.

etc.

THANK YOU !

IN THE SPACES PROVIDED BELOW, YOU ARE ENCOURAGED TO GIVE REASONS FOR SOME OF YOUR ANSWERS; OR YOU MAY BRING UP OTHER SUGGESTIONS WHICH YOU FEEL ARE IMPORTANT FOR IMPROVING SCIENCE EDUCATION IN LESOTHO.

In item 21, my reasons for choosing numbers....7.... and...17..as the two best ways for improving science education in Lesotho are:

(7) It is a way of motivating students and also making them aware of how interesting Science could be. It also shows them how capable in Science they could be in comparison to Students from other Schools.

(17) From my experience as a Science Student I started enjoying Science when we went for excursions and field trips.

My reasons for choosing numbers...2.....and...11...as the two least important recommendations for improving science education in Lesotho are:

I think that in the study and learning of Science, it has nothing to do with the gender issues. Science is not a social subject. It is a field on its own.

I don't think consulting interested people would contribute in the learning of Science.

What other suggestions can you give for improving science teaching and learning in Lesotho?

Please give reasons for your suggestions.

(i) Science teachers who have performed well should be given some awards as incentive. This provide motivation amongst science teachers

(ii) They should be given some allowance too as this is a very tiring job/work

THANK YOU !

IN THE SPACES PROVIDED BELOW, YOU ARE ENCOURAGED TO GIVE REASONS FOR SOME OF YOUR ANSWERS; OR YOU MAY BRING UP OTHER SUGGESTIONS WHICH YOU FEEL ARE IMPORTANT FOR IMPROVING SCIENCE EDUCATION IN LESOTHO.

In item 21, my reasons for choosing numbers 10 **and** 19 **as the two best ways for improving science education in Lesotho are:**

- The basic foundation of science education is in Primary. If students do not grasp concepts there, it will not be easy.
- Practice makes perfect, the more students practice science, the better.

My reasons for choosing numbers 5 **and** 20 **as the two least important recommendations for improving science education in Lesotho are:**

Most Scientific terms cannot be translated to Sesotho, so if science is taught in Sesotho there will be more confusion.
Most students who do not study science related courses in tertiary are not talented in science and its not applicable to their courses so it will be unfair to force them to do sciences.

What other suggestions can you give for improving science teaching and learning in Lesotho?

Please give reasons for your suggestions.

The government of Lesotho should motivate both teachers and students for their hard work. Without motivation, no success.
Career guidance should be done right from primary schools.

THANK YOU !

IN THE SPACES PROVIDED BELOW, YOU ARE ENCOURAGED TO GIVE REASONS FOR SOME OF YOUR ANSWERS; OR YOU MAY BRING UP OTHER SUGGESTIONS WHICH YOU FEEL ARE IMPORTANT FOR IMPROVING SCIENCE EDUCATION IN LESOTHO.

In item 21, my reasons for choosing numbers...1..... and...9...as the two best ways for improving science education in Lesotho are:

In Lesotho Science seems to be something impratical to some students in general. Thus, the students are not able to relate what they are taught in class to the practical world around them. Sometimes even teachers fail to relate science to the real world.

My reasons for choosing numbers...2.....and.....6..as the two least important recommendations for improving science education in Lesotho are:

2. Gender issues are not so crucial in the presentation of science however they may help in resolving problems involving sex.

6. Science is global and it has to be treated accordingly. It is in engineering that the focus must be on resolving problems of underpriviled majority.

What other suggestions can you give for improving science teaching and learning in Lesotho?

Please give reasons for your suggestions.

In the primary Schools, teachers must specialize like in the Secondary Schools so that the science teachers will be specialists in science.

THANK YOU !

IN THE SPACES PROVIDED BELOW, YOU ARE ENCOURAGED TO GIVE REASONS FOR SOME OF YOUR ANSWERS; OR YOU MAY BRING UP OTHER SUGGESTIONS WHICH YOU FEEL ARE IMPORTANT FOR IMPROVING SCIENCE EDUCATION IN LESOTHO.

In item 21, my reasons for choosing numbers 1 **and** 15 **as the two best ways for improving science education in Lesotho are:**

Science is a practical subjects so it is thoroughly understood when it is done practical. i.e more Labs libraries, Science Equipment Computers should be introduced. Students should take Science as what the do in everyday life,

My reasons for choosing numbers 4 **and** 6 **as the two least important recommendations for improving science education in Lesotho are:**

Because Science according to me is less concerned as far as the development of the Community is Concerned either Socially or economically.

What other suggestions can you give for improving science teaching and learning in Lesotho?

Please give reasons for your suggestions.

Each schools should really employ student teachers. Not just ordinary graduants.
Reason:
Graduants are not as equiped as student teachers in teaching methods because: pupils to understand concept need both content and teaching methods.

THANK YOU !

IN THE SPACES PROVIDED BELOW, YOU ARE ENCOURAGED TO GIVE REASONS FOR SOME OF YOUR ANSWERS; OR YOU MAY BRING UP OTHER SUGGESTIONS WHICH YOU FEEL ARE IMPORTANT FOR IMPROVING SCIENCE EDUCATION IN LESOTHO.

In item 21, my reasons for choosing numbers 15 **and** 5 **as the two best ways for improving science education in Lesotho are:**

(1) there are reports of limited resources in many schools - eg lack of laboratory assistants etc.

(2) Language seems to be one major contributory factor to students' low performance in Science - ie there is an apparent association of English with good/effective instruction by educators in Lesotho, yet this foreign colonial language presents serious communication problems

My reasons for choosing numbers 2 **and** 7 **as the two least important recommendations for improving science education in Lesotho are:**

(a) Gender issues have gained importance in the European contexts (+ Western Context) due to the highly sexist nature of these societies => Gender is not a major problem in Lesotho - (we have more ~~impor~~ serious issues to address).

(b) While competitions may be useful - the other issues listed seem to be more important.

What other suggestions can you give for improving science teaching and learning in Lesotho?

Please give reasons for your suggestions.

Important that we draw on the local forms of knowledge ("indigenous" knowledge systems) in the Science curricula - for relevance and expansion of the scientific knowledge base.

THANK YOU !

IN THE SPACES PROVIDED BELOW, YOU ARE ENCOURAGED TO GIVE REASONS FOR SOME OF YOUR ANSWERS; OR YOU MAY BRING UP OTHER SUGGESTIONS WHICH YOU FEEL ARE IMPORTANT FOR IMPROVING SCIENCE EDUCATION IN LESOTHO.

In item 21, my reasons for choosing numbers 6 **and** 12 **as the two best ways for improving science education in Lesotho are:**

(6) Most of the Basotho in the rural areas are underprevilaged to the latest technology. Serious focus should be implemented to them. They should be helped to identify their problems as scientific not culturally.

12) Lately technology is monitored with the use of Computers to facilitate even efficient Communication.

My reasons for choosing numbers 5 **and** 20 **as the two least important recommendations for improving science education in Lesotho are:**

(5) Sesotho language has been a problem over a long period of time in imparting Scientific knowledge. High misconceptions are experience with the use of Sesotho language.

(20) Science is not the only subject to determine individuals future. By so doing I think we will create very large groups of disadwantaged people as they will not be admitted to tertiary levels without Science.

What other suggestions can you give for improving science teaching and learning in Lesotho?

Please give reasons for your suggestions.

- Funds - Most of the Lesotho Schools cannot afford to buy some of the important equipment (scientific). I suggest the Authorities or government look for financial donors.

- Human resources - Very ~~two~~ few Citizens are experts in Science - Science and Maths traditionally have been regarded as the most difficult Subjects. As a result many People escape from pursuing Scientific Studies

- In most cases we depend on expartrates

- Regular work-shops organization. People when meeting regularly, the tend to share ideas ~~and~~ veiws and opinions for proper and adequate implementation.

THANK YOU !

IN THE SPACES PROVIDED BELOW, YOU ARE ENCOURAGED TO GIVE REASONS FOR SOME OF YOUR ANSWERS; OR YOU MAY BRING UP OTHER SUGGESTIONS WHICH YOU FEEL ARE IMPORTANT FOR IMPROVING SCIENCE EDUCATION IN LESOTHO.

In item 21, my reasons for choosing numbers..10**.... and..**22**as the two best ways for improving science education in Lesotho are:**

If the Students have a good background of Science they would not have problems to proceed with Science Studies. Making Science an entry requirement would encourage Students to work hard!

My reasons for choosing numbers....5**.....and..**18**....as the two least important recommendations for improving science education in Lesotho are:**

Some of the parents are not aware about the benefits of Science So it would not be easy for them to encourage their children to study Science. It cannot be easy to use our mother tongue because some of the terminology used in Science are not there in our language. According to our language dissolving and melting have the same meaning (qhibitila) yet they are not the same

What other suggestions can you give for improving science teaching and learning in Lesotho?

Please give reasons for your suggestions.

Activities like Maths & Science fair Should be improved as to promote creativity and the references that are used in schools Should be advanced.

THANK YOU !

IN THE SPACES PROVIDED BELOW, YOU ARE ENCOURAGED TO GIVE REASONS FOR SOME OF YOUR ANSWERS; OR YOU MAY BRING UP OTHER SUGGESTIONS WHICH YOU FEEL ARE IMPORTANT FOR IMPROVING SCIENCE EDUCATION IN LESOTHO.

In item 21, my reasons for choosing numbers 3 **and** 19 **as the two best ways for improving science education in Lesotho are:**

People are more inclined to do anything that helps to improve their environment. Teaching methods are best ways of inculcating the environmental education.

My reasons for choosing numbers 12 **and** 18 **as the two least important recommendations for improving science education in Lesotho are:**

Computers are not widely used in Lesotho for teaching science. We can hardly afford basic science equipment what more with computers!!!
Science is better learned through intrinsic drive by pupils rather than external motivation.

What other suggestions can you give for improving science teaching and learning in Lesotho?

Please give reasons for your suggestions.

We need first improve the science teaching force other improvement will follow.

THANK YOU !

IN THE SPACES PROVIDED BELOW, YOU ARE ENCOURAGED TO GIVE REASONS FOR SOME OF YOUR ANSWERS; OR YOU MAY BRING UP OTHER SUGGESTIONS WHICH YOU FEEL ARE IMPORTANT FOR IMPROVING SCIENCE EDUCATION IN LESOTHO.

In item 21, my reasons for choosing numbers..3.... **and**.15..**as the two best ways for improving science education in Lesotho are:**
for Sustainable development the natural resources should be preserved e.g. Soil which is land. Education should encampus environmental issues concerning environment. Youths should be taught how to preserve it, because it is their mostly needed resource. Articles listed in item 15 assist one in following concepts and testing facts, enlightens all science theories.

My reasons for choosing numbers..2......**and**..5.....**as the two least important recommendations for improving science education in Lesotho are:**
Gender should not be taken into consideration in learning Science. World is both for Men and Women, no group should be more privilleged than another in Science careers. English is a recommended medium which co-ordinates different individuals globally. Science has its own language or terminology, it is not wise to use Sesotho.

What other suggestions can you give for improving science teaching and learning in Lesotho?

Please give reasons for your suggestions.
Teaching force should have optimum knowledge in the area of Science ⇒ Reason: More intensive training for Science teacher is highly recommended.
Curriculum review should be done regularly; Inservice training for teacher is very essential; Scientific equipment that is up to date can improve science education. Pupils should encourage in clubs and awards used as incentives

THANK YOU !